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GOAL ORIENTATION AND FEEDBACK SIGN AS PREDICTORS OF CHANGES IN MOTIVATION AND PERFORMANCE

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Arts

in

The Department of Psychology

by
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Abstract

This study examined the dimensions of goal orientation as moderators of the effects of feedback sign on changes in self-efficacy, effort, and performance over time. In general, the effect of feedback sign on changes in self-efficacy, effort, and performance was hypothesized to be strong for individuals high on performance goal orientation (PGO) and weak for individuals high on learning goal orientation (LGO). Participants completed several performance blocks of an implicit learning task that required individuals to control the temperature of a simulated chemical reactor. Participants were given manipulated normative feedback after each trial. Self-efficacy, effort, and performance were assessed at several points during the session. Hierarchical linear modeling (HLM) was used to examine how self-efficacy, effort, and performance changed over the course of the experiment and the extent to which feedback sign and goal orientation predicted these changes. Significant findings included a main effect of feedback sign on changes in self-efficacy and effort. In addition, LGO interacted with the feedback manipulation in its effects on self-efficacy change, such that changes in the self-efficacy of individuals high in LGO were less influenced by feedback sign than changes in the self-efficacy of individuals low in LGO. Contributions of this research are discussed, including implications for giving feedback in organizations and for improving training programs.

Introduction

The changing nature of work has placed greater demands on employees to continually acquire new skills and knowledge (Ilgen & Pulakos, 1999). Because of these new demands, individual difference variables that impact learning and performance improvement are of increased interest in industrial/organizational (I/O) psychology. Goal orientation is one such individual difference variable that may be important because of its emphasis on individuals' beliefs about learning and reactions to feedback (e.g., Farr, Hofmann, and Ringenbach, 1993; Ford, Smith, Weissbein, Gully, & Salas, 1998; VandeWalle, 1997; VandeWalle, Ganesan, Challagalla, & Brown, 2000). Goal orientation theorists have generally identified two distinct types of goals--*mastery goals* and *performance goals* (Ames & Archer, 1987; Dweck, 1986; Elliot, 1999; Nicholls, 1984)--that differ in the way that competence is defined. *Mastery* (or *learning*) *goals* focus on learning and developing skills or knowledge, while *performance goals* emphasize either demonstrating one's competence relative to comparison others (*performance-prove goals*) or avoiding displays of incompetence (*performance-avoid goals*) (Elliot, 1999).

In addition to exploring individual differences, research must better understand the role feedback plays in the learning and performance improvement processes. Generally speaking, negative feedback has been thought to lead to increased performance because individuals are motivated to decrease the discrepancy between their performance and goals. Positive feedback, on the other hand, signals to the individual that performance is better than expected, resulting in little additional effort, or even decreased effort (Carver & Scheier, 1998). Although a great deal of research has examined the effects of feedback on subsequent performance and motivation (e.g., Carver & Scheier, 1998; Ilgen, Fisher, & Taylor, 1979; Kluger & DiNisi, 1996), relatively little is known regarding how feedback impacts performance over time and how feedback might interact with individual differences to impact subsequent motivation and performance. Consistent with this idea, Kluger and DiNisi (1996) proposed that individual differences in personality may play a role in determining the extent to which positive and negative feedback impact performance.

An important research question involves how goal orientation and feedback combine to affect motivation and performance on a learning task. Recent research has begun to explore this issue (e.g., VandeWalle, Cron, and Slocum, 2001) but has not yet examined how feedback sign and goal orientation affect the process of performance improvement. That is, feedback sign and goal orientation may not only impact initial motivation and performance but might also contribute to the development of self-efficacy and changes in effort and performance over time. The present study examined the extent to which changes in self-efficacy, effort, and performance are predicted by the sign of feedback (negative or positive), individual differences in goal orientation, and the interaction between these variables.

Literature Review

Goal Orientation

It has been well established that goals play a dramatic role in influencing performance (Locke & Latham, 1990). Most research supporting this assertion has focused on the nature of task-specific goals (i.e. characteristics of goals such as specificity and difficulty, acceptance and commitment, and goal source) and on how these goal characteristics affect performance. Recently, however, there has been a great deal of interest in the role dispositional factors play in influencing motivation and performance in achievement contexts (e.g., Farr et al., 1993; Kanfer & Ackerman, 2000; Kanfer & Heggestad, 1997). Goal orientation is one such individual difference construct that has been shown to influence performance expectations, task choice, persistence, effort, and reactions to failure (Brett & VandeWalle,1999; Elliot, McGregor, & Gable, 1999; Farr et al., 1993).

Most research on goal orientation has distinguished between two major types of goals, albeit using different labels. Nicholls (1984) contrasted individuals who are ego-involved with those who are task-involved. Ego-involved individuals judge their own ability in terms of their effort or performance relative to others', whereas task-involved individuals judge their ability relative to their own past ability and gains toward mastery of the task. Similarly, Dweck (1986) distinguished between learning goals, where the aim is to increase one's competence and/or learn something new, and performance goals, where the aim is to demonstrate competence or avoid negative judgments. These formulations are also similar to Ames (1984) and Butler (1992), who differentiated mastery goals from ability goals. Ames and Archer (1987) argued that these various conceptualizations are similar enough to refer to them by one distinction—mastery goals, which focus on developing competence and learning/mastering a new task, versus performance goals, which focus on demonstrating ability in comparison to others.

Dweck (1986) theorized that differences in individuals' goal orientations stem from differences in implicit theories of intelligence. Individuals who hold entity theories of intelligence believe that intelligence is relatively fixed, and consequently difficult to improve. On the other hand, individuals with incremental theories of intelligence believe that intelligence is malleable and that competence can be increased. Dweck (1986) noted that children chose either performance goals or learning goals, based on their theory of intelligence. If a child believed intelligence was a fixed trait (i.e., held an entity theory of intelligence), he/she tended to focus on gaining favorable judgments of that trait and oriented toward performance goals. However, if a child believed intelligence was malleable (i.e., held an incremental theory of intelligence), he/she tended to aim at attainment of this quality through pursuit of learning goals.

Dweck and Leggett (1988) also found that learning goals consistently produce an adaptive motivational pattern, whereas performance goals lead to either adaptive or maladaptive motivational patterns, depending upon whether that individual's self-perceived ability is high or low (respectively). The adaptive motivational pattern includes challenge seeking, persistence in the face of difficulty, and enjoyment of effort toward task mastery. However, the maladaptive motivational pattern includes avoiding challenges, failure to persist through obstacles, and negative affect and self-cognition (e.g., attributions of low ability) in the face of difficulty (Dweck & Leggett, 1988).

Goal orientation also appears to affect the meaning individuals place on effort. Dweck and Leggett (1988) reported that those individuals with performance goals tended to view effort as an index of ability. In other words, they thought that the more effort they put forth, the less ability they would appear to have. On the other hand, those who adopted learning goals viewed effort as a strategy to be used to master the task, such that more effort could lead to better learning.

Note that early work (e.g. Dweck, 1986; Dweck & Leggett, 1988) conceptualized goal orientation as a unidimensional construct with opposing poles of strong performance orientation and strong learning orientation. However, there is now evidence that the two orientations are neither mutually exclusive, nor contradictory (Brett & VandeWalle, 1999; Button, Mathieu, & Zajac,1996). In other words, an individual can be high or low on both orientations. Furthermore, recent conceptualizations have shown that performance goal orientation can be divided into approach and avoidance components (performance-prove orientation versus performance-avoid orientation). This conceptualization will be discussed in more detail in a later section.

In addition to understanding the dimensionality of the construct, it is important to note that goal orientation has been examined as both a state and a trait variable. Although most research in I/O psychology has adopted the dispositional approach, some researchers (e.g., Butler, 1993; Elliott & Dweck, 1988; Steele-Johnson, Beauregard, Hoover, & Schmidt, 2000) have examined the effects of assigning and/or manipulating learning and performance goals on several outcome variables. For example, Steele-Johnson, Beauregard, Hoover, and Schmidt (2000) manipulated goal orientation with task instructions, claiming that performance was either difficult to improve (performance goal), or changeable through effort (learning goal), and emphasizing either achievement (performance goal), or mastery of the task (learning goal). They found that goal orientation interacted with task difficulty in affecting performance, such that individuals with performance goals outperformed those with learning goals on an easy task, but not a difficult task. In a second study, goal orientation interacted with task consistency, such that those with learning goals reported higher self-efficacy and intrinsic motivation on an inconsistent task, whereas those in the performance goal condition reported higher levels of self-efficacy on a consistent task. Overall, these results suggest that individuals assigned a learning goal perform better and have stronger motivation under complex, difficult conditions than individuals assigned a performance goal.

Researchers operationalizing goal orientations as stable individual traits have found correlations with performance and motivational variables (e.g., Button et al., 1996; Ford et al., 1998; Phillips & Gully, 1997; VandeWalle, 1997). For example, Phillips and Gully (1997) measured goal orientation and found that learning orientation was positively related and performance goal orientation was negatively related to self-efficacy, which in turn was positively related to both self-set goal level and performance.

A Three-dimensional Conceptualization of Goal Orientation

As mentioned previously, researchers have recently developed a three-dimensional conceptualization of goal orientation that divides performance goals into approach and avoidance components (e.g., Elliot, 1999; VandeWalle, 1996; 1997; VandeWalle et al., 2000; VandeWalle et al., 2001). In other words, people can differ in performance-prove orientation (the approach component), where the aim is to prove their ability in comparison to others and attain favorable judgments of their competence, and in performance-avoid goal orientation, where the aim is to avoid displays of incompetence and/or negative judgments from others. Mastery (or learning) goal orientation remains unchanged in the new conceptualization, resulting in three separate dimensions of goal orientation: mastery (or learning), performance-prove, and performance-avoid (Elliot, 1999).

Elliot and Haraciewicz (1996) found support for this three-dimensional framework in two empirical studies. In both studies, they manipulated goal orientation with instructions that either promoted learning (mastery condition), called the participants attention to the chance of looking better than others (performance-approach) or emphasized the chance of looking worse than others (performance-avoid). Results showed performance-avoid goals undermined intrinsic motivation, while performance-approach and learning goals did not. These results provide support for the distinction between the two performance goals (Elliot & Haraciewicz, 1996) and suggest that performance-approach orientation may lead to a pattern of behavior similar to that of learning goal orientation.

Using more of an individual differences approach, Elliot and Church (1997) found similar results in a classroom setting. Specifically, they found that performance-avoid goals were negatively related and mastery goals were positively related to intrinsic motivation, but performance-approach goals were not related to intrinsic motivation. In addition, although both performance-approach and performance-avoid goals were predicted by fear of failure, performance-approach goals were also positively predicted by achievement motivation and competence expectancies, and performance-avoid goals were negatively predicted by competence expectancies (Elliot & Church, 1997).

In a study on achievement goals and exam performance, Elliot, McGregor, and Gable (1999) found that performance-approach goals were positively related to exam performance, and performance-avoid goals were negatively related to exam performance (mastery goals were not significantly related to performance). In addition, learning goals and performance-approach goals positively predicted persistence and effort, whereas performance-avoid goals were unrelated to these variables. Instead, performance-avoid goals positively predicted disorganization (i.e., low structure and organization in studying), but performance-approach and learning goals were unrelated to disorganization.

Results from these studies provide support for the three-dimensional framework by revealing different antecedents and consequences for the three dimensions of goal orientation (Elliot et al., 1999). Based on these findings, the present study adopts the three-dimensional conceptualization of goal orientation.

Goal Orientation Research in I/O Psychology

Farr et al. (1993) argued that the study of goal orientation has great significance for I/O psychology because of its implications for research in areas such as goal setting, performance feedback, and training. Most work-related goal orientation research has utilized the two-dimensional conceptualization of goal orientation. For example, Ford, Smith, Weissbein, Gully, and Salas (1998) examined the role of mastery and performance orientation in the acquisition of a complex skill during training. They found that mastery orientation was positively related to metacognitive activity of the learner, which in turn was significantly related to knowledge acquisition, skilled performance, and self-efficacy. Goal orientation also had direct effects on self-efficacy. Mastery orientation was positively related to self-efficacy, whereas performance orientation was negatively related to self-efficacy. This set of findings is important because self-efficacy then had a direct effect on performance transfer to a new task.

More recently, VandeWalle and colleagues have demonstrated the usefulness of the three-dimensional operationalization of goal orientation in I/O psychology (e.g., Brett & VandeWalle, 1999; VandeWalle, 1997). For example, Brett and VandeWalle (1999) examined trait goal orientation as a predictor of the content of individuals' self-set goals for a training program on business presentations. They found that learning orientation was positively related to setting goals dealing with developing and refining presentation skills. Performance-prove goal orientation was positively related to comparison goals (aimed at presenting better than colleagues) and performance-avoid goal orientation was related to avoidance goals (aimed at not looking bad) (Brett &

VandeWalle, 1999). Their study is significant in that it further supports the three-dimensional goal orientation conceptualization and demonstrates relationships between these dimensions and work-specific goals.

A recent article by VandeWalle, Cron, and Slocum (2001) examined the relationship of individual differences in learning goal orientation, proving goal orientation, and avoiding goal orientation with academic performance before and after the receipt of feedback. They found that learning goal orientation was positively correlated and avoiding goal orientation was negatively correlated with performance both before and after feedback. On the other hand, performance-prove goal orientation, although initially positively correlated with performance, was unrelated to performance after feedback. In addition, learning goal orientation positively predicted and avoiding goal orientation negatively predicted self-efficacy following feedback, whereas proving goal orientation was unrelated to post-feedback self-efficacy. These findings suggest that the positive effects of performance-prove orientation may diminish after feedback. They also provide evidence that differences in goal orientation may impact individual reactions to feedback and subsequent motivation and performance.

Although the VandeWalle et al. (2001) study takes an important first step in examining how the relationship between goal orientation and outcome variables changes after feedback, there are two limitations to their findings. First, they did not differentiate the nature of the feedback that participants received (positive or negative), which has been shown to impact subsequent behavior (Ilgen et al., 1979). By not distinguishing between positive and negative feedback, it is impossible to determine whether individuals with different goal orientations respond the same to positive and negative feedback. In fact, previous research (e.g., Elliot & Dweck, 1988) suggests that individuals with different goal orientations do react differently to positive and negative feedback, suggesting that the VandeWalle et al. (2001) study may have masked an interaction between feedback sign and goal orientation. A second limitation to the VandeWalle et al. (2001) study is that only one feedback episode was examined. It may be that the effects of goal orientation and feedback on motivation and performance take time to develop. In addition, examining these variables over multiple performance episodes may provide a more realistic picture of the relationships between these variables in the workplace. Both feedback sign and the benefits of longitudinal research are discussed in more detail in the following sections.

Feedback Intervention Theory (FIT)

Since scientists began studying feedback nearly 100 years ago, there have been conflicting findings on the influence of feedback interventions (FIs) on performance. Kluger and DiNisi (1996) explain the effects of feedback on behavior with Feedback Intervention Theory (FIT), which is derived from a control theory model of human behavior (Carver & Scheier, 1998). A central tenant of FIT is that the effectiveness of feedback is determined by the extent to which feedback focuses a person’s attention on the task and not on the self.

According to FIT, goals (or standards) are organized into a complex hierarchy, with the top of the hierarchy containing goals of the self (i.e., become a successful businessperson), and the bottom of the hierarchy containing physical action goals (i.e., open the door). For simplicity's sake, Kluger and DiNisi (1996) categorize the processes associated with different levels of this hierarchy into three abstract levels: meta-task processes, which involve the self, task-motivation processes, which involve the task at hand, and task-learning processes, which involve the very specific details of that task.

Because attention is limited, individuals can only focus on one level at a time. FIT argues that attention is usually directed at intermediate levels of the hierarchy; that is, individuals usually direct their attention to task-motivation processes (e.g., write a paper), and not to the very detailed components of the task at hand (e.g., pick up the pencil) or to the ultimate goals of the self (e.g., become a better person). FIs are hypothesized to direct a person's attention to other levels, depending on the characteristics of the feedback. In addition, comparison of feedback to a goal or standard can result in a positive discrepancy (i.e., performance above the standard), negative discrepancy (i.e., performance below the standard), or no discrepancy (i.e., performance at the standard). According to control theory (Carver & Scheier, 1998), individuals are motivated to reduce any discrepancies; therefore, one would expect a negative discrepancy to lead to increased effort and a positive discrepancy to lead to decreased or sustained effort.

FIT proposes that, after receiving positive feedback, an individual will most likely reduce or sustain effort, maintaining attention at the task-motivation level of the hierarchy, unless that individual perceives an opportunity to attain higher-level goals of the self. For example, if a student's goal on a chemistry test is to obtain a C, and he/she receives a B, that individual may maintain the same amount of effort or even reduce effort on the next test. However, if that person has a superordinate goal to become a chemist, he/she may increase effort for the next test, raising his or her test grade goal. Upon receipt of negative feedback, FIT predicts that an individual will first focus attention at lower levels of the hierarchy and increase effort in order to reduce the discrepancy (i.e., negative feedback causes an individual to devote attention to how he/she can improve, which involves turning attention to task-learning processes). If the negative discrepancy is not eliminated after repeated attempts, individuals will eventually attempt to reduce the discrepancy by directing attention to higher levels of the hierarchy, where they may abandon or revise the superordinate goal. That is, individuals will direct attention to the meta-task level and change the standard to match performance. However, there may be individual differences in how quickly individuals will shift attention away from the task and to higher-level goals in the face of repeated negative feedback. Kluger and DiNisi (1996) suggest that one such variable may be an individual's belief in success. For individuals with a high belief in success, attention is predicted to remain on the task longer; however, for individuals with a low belief in success, attention will likely shift to the self (higher level) where individuals may reevaluate their higher-order goals.

Kluger and DiNisi (1996) discuss the possibility that individual differences in personality may impact how individuals react to feedback. Consistent with this idea, Ilgen et al. (1979) found that self-esteem and locus of control influenced the way individuals reacted to an FI. These authors argue that individual differences determine preferences for attention allocation, as well as patterns of resolving feedback-standard discrepancies. In addition, Kluger and DiNisi (1996) note that people who have the self goal of "avoiding negative stimuli" are more likely to direct attention to the self upon receiving negative feedback because that feedback is quite salient to their higher-level goals. Because of goal orientation's emphasis on higher-order goals of the self (e.g., "learn as much as I can;" "prove myself to others;" "avoid looking stupid"), it may impact how individuals allocate attention and effort following feedback.

The Importance of Understanding Within-subject Changes

The majority of previous research on the effects of goal orientation and feedback on task-specific motivation and performance has used correlational designs involving one or two measurement occasions (e.g., Colquitt & Simmering, 1998; Phillips & Gully, 1997; VandeWalle et al., 2001). Although much of this research supports the relationships of goal orientation and feedback with motivation and performance, these studies are cross-sectional in nature and unable to capture the potential richness and changes in these relationships over time. Specifically, some researchers (e.g., Deadrick, Bennett, & Russell, 1997; Eyring, Johnson, & Francis, 1993) have argued that the complexity of the relationships between variables is best revealed using both between-subject and within-subject analyses. An example of how this approach can be helpful is the relationship between self-efficacy (i.e., belief in one's ability to perform a task) and performance. Previous cross-sectional research on self-efficacy and performance has found a positive relationship between these variables and has concluded that self-efficacy benefits subsequent performance (Gist, 1987). However, Vancouver, Thompson, and Williams (2001) and Vancouver, Thompson, Tischner, and Putka (2002) recently examined the link between self-efficacy and performance using both within-subject and between-subject analyses and made very different conclusions. In particular, the between-subject results supported a positive self-efficacy and performance relationship, but within-subject analyses showed that self-efficacy was positively related to prior performance and negatively related to subsequent performance (suggesting a complacency effect). Clearly, previous work using between-subject analyses masked the complexity of the self-efficacy and performance relationship.

Additionally, in a study on the effects of individual differences in skill acquisition, Eyring, Johnson, and Francis (1993) examined ability, self-efficacy, and task familiarity as predictors of within-subject learning curves. These within-subject analyses revealed that individuals with high ability, self-efficacy, and task familiarity had slower growth rates in learning over time (probably because these individuals started out closer to asymptotic performance) than individuals low on these attributes. Similarly, Deadrick, Bennett, and Russell (1997) found that psychomotor ability predicted the initial performance of sewing machine operators, but cognitive ability was a better predictor of performance improvement over time. They concluded that determinants of initial performance might differ from determinants of performance improvement, emphasizing the importance of examining within-subject changes. Noting that variables in their study (i.e., experience, cognitive ability, and psychomotor ability), only accounted for 5% of the variance in rate of performance change over time, Deadrick et al. (1997) concluded that important unmeasured moderators of performance change likely exist.

The above studies call our attention to the importance of examining between-subject predictors of within-subject change. To examine such between- and within-subject effects, it is necessary to analyze data at multiple levels (Bryk & Raudenbush, 1992). Specifically, the within-subject analysis of these changes can be represented by individual lines (or curves) defined by an intercept and slope, which may be linear, quadratic, or cubic in form. The extent to which situational factors and individual difference variables predict the individual intercepts and slopes can be determined as well. The statistical analyses used to examine this multi-level data, hierarchical linear modeling (HLM), will be discussed in the analytic strategy section of this paper.

Present Investigation

In Farr et al.'s (1993) discussion of the importance of goal orientation research in I/O psychology, they proposed that individuals with different goal orientations might have different reactions to performance feedback. Based on previous goal orientation research and theory, several differences between learning goal orientation and performance goal orientation may be expected. First, individuals high in learning orientation are more likely to view negative feedback as a tool for developing task mastery, whereas individuals high in performance orientation (prove and avoid) are more likely to see it as evaluative and threatening (Farr et al., 1993; VandeWalle et al., 2001). Second, goal orientation may influence the saliency of positive versus negative performance feedback (Farr et al., 1993; VandeWalle et al., 2001). While those with learning goals may focus on parts of the feedback that were positive, those with performance goals are especially sensitive to failure-relevant information because of their entity view of ability (Elliot & Harackiewicz, 1996; VandeWalle et al., 2001). Specifically, they perceive failure as a sign of low ability; therefore, for individuals high in performance orientation, negative feedback may threaten their self-efficacy for future performance because an increase in ability seems unlikely. Third, VandeWalle et al. (2001) suggested that highly task-focused individuals (those with learning goals) are more likely to retain cognitive resources at the task level when receiving feedback, while ego-involved individuals (those with performance goals) may shift attention to the self upon receiving negative feedback, therefore resulting in a decrease in cognitive resources available for task performance (Kluger & DiNisi, 1996).

Elliot and Harackiewicz (1996) point out that a remaining key question with regard to goal orientation is whether the positive motivational effects of a performance-prove goal can be maintained in the face of negative feedback. Research has shown that the positive relationship of performance-prove goal orientation with performance decreases after intermittent or continuous feedback; learning goal orientation, on the other hand, remains positively associated with performance, while avoiding goal orientation remains negatively associated with performance (e.g., Elliot et al., 1999; Ford et al., 1998; VandeWalle et al., 1999).

VandeWalle et al. (2001) recommended that future research on goal orientation include an experimental design that manipulates the sign of feedback. Consistent with this suggestion, the present study manipulated the sign of feedback and measured the three dimensions of goal orientation (VandeWalle, 1997). This approach enabled the examination of the relationship of goal orientation and positive versus negative feedback with the dependent variables, as well as the interactive effects of these variables.

VandeWalle et al. (2001) also note that future research should examine the effects of goal orientation and feedback on motivation and performance over several episodes of task performance because the nature of these effects may change over time. Therefore, a second major purpose of this study was to determine the extent to which between-subject characteristics (differences in goal orientation and feedback sign) predict within-person changes in motivation and performance over time. Eyring et al. (1993) illustrated the ability of multilevel-analysis techniques to examine how individual differences can predict within-person changes in other variables (i.e., performance). In the present study, relevant outcome variables (i.e., self-efficacy, effort, and performance) were measured at several points in time to determine the pattern of each variable within an individual over time (represented by the slope and intercept of a line). It was then possible to examine whether these lines were predicted by feedback sign and goal orientation.

Goal Orientation and Feedback Effects on Self-efficacy

This study examined the effects of feedback sign and goal orientation on initial self-efficacy and changes in self-efficacy. Self-efficacy is defined as an individual's belief about his/her own capability to perform a specific task (Gist, 1987; Bandura, 1997). Self-efficacy is generally enhanced by successful performance of a task, and lowered by failure (Bandura, 1997). Therefore, it was hypothesized that feedback sign would impact changes in self-efficacy over trials, such that individuals receiving repeated positive feedback should exhibit increasing self-efficacy over trials, and individuals receiving repeated negative feedback should exhibit decreasing self-efficacy over trials. In addition, it was anticipated that the effects of feedback sign on changes in self-efficacy would be moderated by goal orientation.

Prior to receiving task feedback, goal orientation should predict individuals' initial self-efficacy (intercept). Consistent with the notion that goal orientation is related to differences in implicit theories of ability, Kanfer (1990) suggested that individuals with performance goals experience lower self-efficacy across tasks than those with learning goals. In addition, past research has shown that learning orientation is positively related to initial self-efficacy, whereas performance orientation is negatively related to initial self-efficacy (e.g., Diefendorff, 2002; Phillips & Gully, 1997). These studies utilized a two-dimensional conceptualization of goal orientation; therefore, it is not known whether relationships with self-efficacy differ for performance-prove and performance-avoid orientation. However, because an avoiding goal orientation has been found to have even stronger relationships with the entity theory of ability and with pessimism than a proving goal orientation (e.g., VandeWalle, 1996), it was anticipated that avoiding goal orientation should be even more strongly and negatively correlated with initial self-efficacy than proving orientation. It was therefore predicted that initial level of self-efficacy would be positively predicted by learning orientation, and negatively predicted by the performance orientations, with performance-avoid orientation having a stronger negative relationship with self-efficacy than performance-prove orientation.

Hypothesis 1: Goal orientation predicts an individual's initial self-efficacy on the task, such that:

1a: Learning orientation is positively related to initial self-efficacy.

1b: Performance-prove orientation is negatively related to initial self-efficacy.

1c: Performance-avoid orientation is negatively related to initial self-efficacy.

1d: Performance-avoid orientation has a stronger negative relationship with initial self-efficacy than performance-prove orientation.

Because high performance goal orientation is associated with an entity theory of ability (i.e., the belief that ability is a fixed trait) (Dweck, 1986; Dweck & Leggett, 1988), changes in the self-efficacy of individuals high in performance orientation might be greatly influenced by feedback sign. In essence, more is at stake for these individuals because whatever feedback they are given is taken as a sign of ability. Positive feedback, signaling successful performance, will likely be attributed to high ability and therefore should increase self-efficacy for these individuals. Negative feedback, on the other hand, should decrease self-efficacy because ability is not seen as easily improved. These effects should be even greater for individuals high in performance-avoid orientation because of its especially strong relationships with the entity theory of ability and with pessimism (VandeWalle, 1996); therefore, it was hypothesized that negative feedback should decrease self-efficacy at a faster rate for individuals high in performance-avoid orientation than for individuals high in performance-prove orientation.

For individuals high in learning goal orientation, ability is seen as malleable (Dweck, 1986; Dweck & Leggett, 1988). Feedback is viewed merely as a learning tool and not a sign of ability. Because they do not view past performance levels as a limit to future performance, the self-efficacy of individuals high in learning goal orientation may not be easily influenced by feedback sign. However, individuals low on learning goal orientation may be more strongly influenced by feedback sign.

Hypothesis 2: Feedback sign has a main effect on the change in self-efficacy over performance trials, such that positive feedback is associated with increasing self-efficacy over time, and negative feedback is associated with decreasing self-efficacy over time.

Hypothesis 3: The effects of feedback sign on changes in self-efficacy over time are moderated by goal orientation, such that:

3a: Feedback sign has a strong positive effect on changes in self-efficacy at high levels of performance-prove orientation and a weak effect at low levels of performance-prove orientation.

3b: Feedback sign has a strong positive effect on changes in self-efficacy at high levels of performance-avoid orientation and a weak effect at low levels of performance-avoid orientation.

3c: Feedback sign has a weak effect at high levels of learning orientation and a strong positive effect on changes in self-efficacy at low levels of learning orientation.

Hypothesis 4: The moderating effects of goal orientation on the feedback sign and changes in self-efficacy relationship are stronger for performance-avoid orientation than for performance-prove orientation.

Goal Orientation and Feedback Effects on Effort

Goal orientation and feedback were expected to impact anticipated effort. Effort is considered a basic component of motivation (Kanfer, 1990) and can be defined as the amount of attentional focus that an individual devotes to a task (Kanfer & Ackerman, 1989). Individuals' initial level of effort on a task (before feedback) should be predicted by goal orientation, simply as a result of differential beliefs about effort. Because individuals who are high in learning orientation view effort positively, they are expected to begin the task putting forth more effort than those who are low in learning orientation. The same should be true of individuals high in performance-prove orientation because they should be motivated by the chance to prove themselves to others and will not yet have received feedback. The opposite should be true for those who are high in performance-avoid orientation. Because of their already low beliefs in their ability and their concerns about the possibility of high effort revealing their incompetence, they should begin the task with less effort than those who are low in performance-avoid orientation.

Hypothesis 5: Goal orientation predicts initial level of effort, such that:

5a: Learning orientation is positively related to initial effort.

5b: Performance-prove orientation is positively related to initial effort.

5c: Performance-avoid orientation is negatively related to initial effort.

Kluger and DiNisi (1996) emphasized the idea that individuals compare feedback to their goals, which can result in a positive or negative discrepancy that individuals are motivated to reduce. The most immediate response to a discrepancy is a corresponding change in effort. According to control theory, one would expect positive feedback to lead to decreased effort (Carver & Scheier, 1998). However, Kluger and DiNisi (1996) also note that if individuals receive positive feedback and perceive an opportunity to attain other self-goals (e.g., learning as much as possible), they may instead raise their standards and increase effort.

Also, according to control theory (Carver & Scheier, 1998), one might expect negative feedback to lead to increased effort. In fact, Kluger and DiNisi (1996) hypothesized that individuals will try this strategy first; however, individuals will only maintain or continue to increase effort if it proves to reduce the discrepancy. If increasing effort does not reduce the discrepancy (i.e., if negative feedback persists), attention may be directed to higher levels of the hierarchy, where the superordinate goal is re-evaluated. After receiving repeated negative feedback, individuals will direct their attention to the self level. For example, the individual may wonder: “Why am I doing this?” “Is this really that important to me?” or, “Should I even continue to try?” In other words, attention will shift to re-evaluating and possibly revising higher-level goals. The result of this shift in attention is that fewer cognitive resources will be available for the task. In addition, if the higher-level goal is abandoned, an intentional withdrawal of effort may occur. It was therefore hypothesized that, across individuals, positive feedback would be associated with decreased effort and negative feedback would be associated with increased effort (Carver & Scheier, 1998). However, this effect was expected to be moderated by goal orientation.

In particular, individuals high in performance orientation are more likely than those low in performance orientation to be influenced by feedback sign. Individuals high in performance orientation should be more likely to simply maintain their current effort following positive feedback and eventually reduce effort following repeated negative feedback. This idea is based on the fact that individuals high in performance orientation view high effort as a display of low ability and therefore want to show as little effort as possible (Dweck & Leggett, 1988). In addition, negative feedback should cause them to turn their attention to the self-level more quickly, reducing the cognitive effort available for working on the task. This effect of feedback sign should be stronger for individuals high in performance-avoid orientation than for individuals high in performance-prove orientation because of their already low belief in success and their stronger entity theory of ability (VandeWalle, 1996). Note that individuals high in performance-prove orientation might initially be motivated to increase effort after the first few episodes of negative feedback, as predicted by FIT; however, when this doesn't reduce the discrepancy, they should direct attention to higher levels, reducing cognitive effort. The effort line for those high in performance-prove orientation was therefore expected to have a quadratic shape.

Individuals high in learning goal orientation, on the other hand, were expected to maintain high effort regardless of feedback sign because, (a) consistent with FIT, when they receive positive feedback, they should perceive the opportunity to achieve higher self-goals (i.e., learning as much as possible), and (b) because they believe that ability is malleable, they should maintain the belief in task success even upon receipt of negative feedback. Accordingly, these individuals should be more likely to focus attention (i.e., cognitive effort) on task processes in the face of negative feedback, without turning attention to the self-level as discussed in FIT. In fact, because individuals high in learning orientation will likely begin the task putting forth a high level of effort, they may be unable to increase their effort as much compared to individuals low on learning goal orientation.

Hypothesis 6: Feedback sign has a negative effect on changes in effort, such that positive feedback is associated with decreasing effort and negative feedback is associated with increasing effort.

Hypothesis 7: The relationship between feedback sign and changes in effort is moderated by goal orientation, such that:

7a: Feedback sign has a strong negative effect on changes in effort at high levels of performance-prove orientation and a weak effect at low levels of performance-prove orientation.

7b: Feedback sign has a strong positive effect on changes in effort at high levels of performance-avoid orientation and a weak negative effect at low levels of performance-avoid orientation.

7c: Feedback sign has a weak effect on changes in effort at high levels of learning goal orientation and a strong negative effect for those low in learning goal orientation.

Hypothesis 8: The moderating effects of goal orientation on the feedback sign and changes in effort relationship are stronger for performance-avoid orientation than performance-prove orientation.

Goal Orientation and Feedback Effects on Performance

In achievement tasks such as the present one, performance is expected to increase over time, due to practice. However, the present study proposes that feedback sign should affect this performance improvement by inducing different levels effort (Carver & Scheier, 1998). Therefore, negative feedback was hypothesized to lead to faster increases in performance than positive feedback because of the greater effort it produces. Goal orientation, however, should moderate the relationship between feedback sign and changes in performance over time.

The improvement of individuals high on performance orientation, for example, is more likely to be affected by feedback sign than the improvement of individuals low in performance orientation. These individuals were expected to reduce or simply maintain effort upon receipt of positive feedback. In addition, they were expected to shift their attention to the self upon receipt of negative information, reducing cognitive resources available for the task, and possibly abandoning higher-level goals and effort altogether.

Therefore, improvement should be more dependent upon feedback sign the higher one is in performance orientation. In addition, because of their stronger entity view of ability, those high in performance-avoid orientation were expected to have a stronger effect of feedback sign on performance improvement than those high in performance-prove orientation. Therefore, it was hypothesized that performance-avoid orientation would moderate the effects of feedback sign on improvement to a greater extent than performance-prove orientation.

As previously discussed, individuals high in learning orientation should be less likely than those low in learning orientation to reduce effort upon receipt of positive feedback and may possibly even increase it, due to their strivings to learn as much as possible. In addition, they should be less likely to shift their attention to the self upon receipt of negative feedback. Therefore, improvement in performance should be less dependent on feedback sign the higher one is in learning orientation.

Hypothesis 9: Performance improves over time (across performance blocks).

Hypothesis 10: The rate of performance improvement is predicted by feedback sign, such that those receiving repeated negative feedback improve at a faster rate than those receiving repeated positive feedback.

Hypothesis 11: The relationship between feedback sign and performance improvement over time is moderated by goal orientation, such that:

> 11a: Feedback sign has a strong negative effect on performance improvement at high levels of performance-prove orientation and a weak effect at low levels of performance-prove orientation.

11b: Feedback sign has a strong negative effect on performance improvement at high levels of performance-avoid orientation and a weak effect at low levels of performance-avoid orientation.

11c: Feedback sign has a weak effect on performance improvement at high levels of learning orientation a strong negative effect on performance improvement at low levels of learning orientation.

Hypothesis 12: Performance-avoid orientation is a stronger moderator of the effects of feedback sign on improvement than performance-prove orientation.

Method

Participants

Participants were 190 undergraduate university students who received extra credit in their psychology courses for participating. Ages ranged from 18 to 32 (Mean age = 20.24). Participants were 77.4% White, 70% female, and 21% were psychology majors. Upon arrival at the session, participants were randomly assigned to either the positive feedback condition (N = 94) or the negative feedback condition (N = 96). The two conditions did not differ significantly in the number of males versus females; however, individuals in the negative condition were slightly younger (Mean age = 19.82) than those in the positive condition (Mean age = 20.66).

Bryk and Raudenbush (1992) note that there is still a great deal of question about the sample size required to obtain adequate power using HLM, the type of analysis proposed for the present study. The sample size chosen in the present investigation was based upon sample sizes used in prior longitudinal studies using HLM (e.g., N = 115 in Eyring et al., 1993; N = 115 in Vancouver, 1997; N = 187 in Vancouver et al., 2001).

Task

Participants performed a computerized process control task in which they learned to control the temperature of a simulated chemical reactor. The purpose of this task is to maintain the temperature of the reactor at 6000 degrees by inputting fuel pellets into the reactor. The relationship between the temperature output and the amount of fuel input is determined by the equation: $P = (20 \times W) - P_1$, where P = temperature output; W = the number of fuel pellets put into the reactor; and P_1 = the previous temperature. As a result, the relationship between pellets and temperature is not a simple linear relationship; instead, it depends upon the most recent temperature of the reactor. Because the underlying equation is unknown to the participant, the task is to discover the relationship between fuel and temperature (which is initially done through trial and error) and control that temperature over trials. During the task, a graph on the left-hand side of the screen plots the amount of fuel that individuals input, and a graph on the right-hand side of the screen plots the reactor temperature (output). Figure 1 displays a screen of the chemical reactor task. The participant must select the amount of fuel pellets to input (choices range from 1000 to 12,000 pellets, in increments of 1000) in order to bring the temperature as close to 6000 degrees as possible. Each trial (or screen) begins with the computer generating the initial temperature, followed by 10 responses (fuel pellet inputs) aimed at bringing (and maintaining) the reactor temperature as close to 6000 degrees as possible. After the 10 responses, a new trial begins with the computer randomly generating a new initial temperature, and the participant making 10 more responses.

This task is a variant of one used by Berry and Broadbent (1984) and Stanley, Mathews, Buss, and Kotler-Cope (1989) for studying the role of implicit knowledge

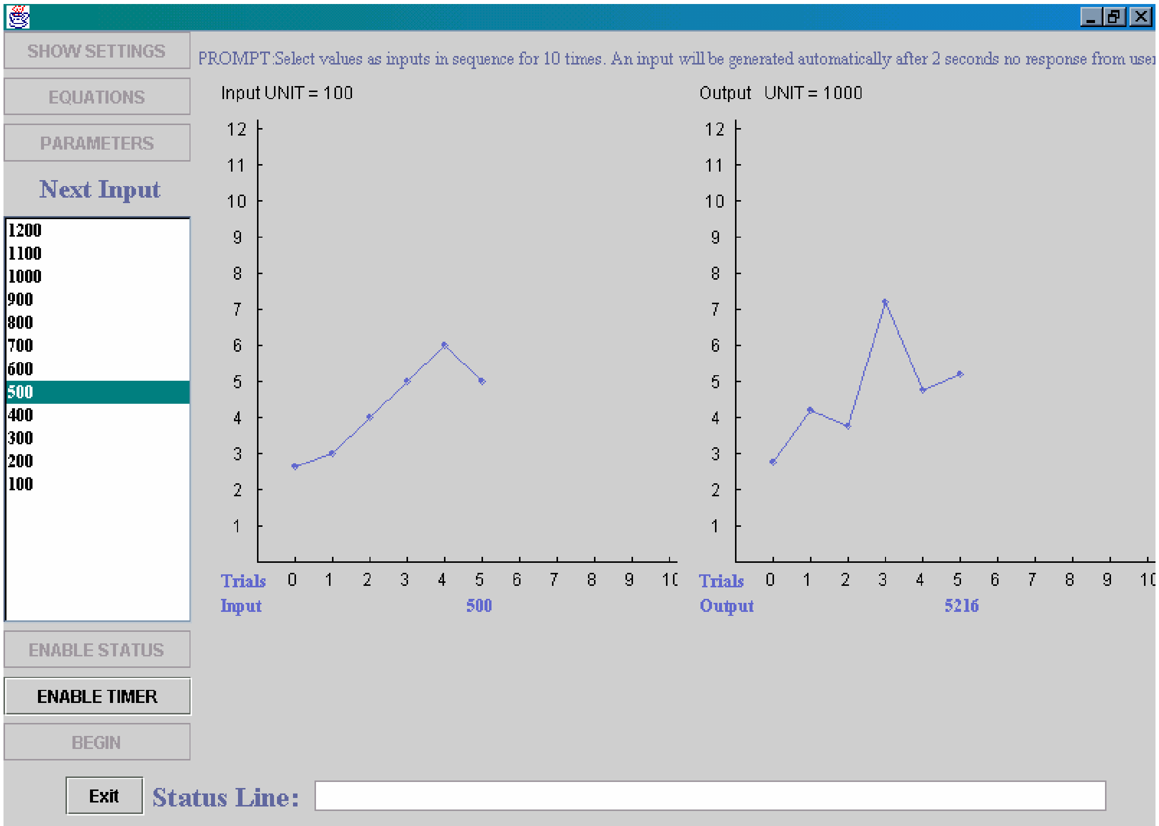


Figure 1. Sample input/output screen.

acquisition in performance improvement. Stanley et al. (1989) note that process control tasks have a great deal of generalizability to real-world behavior because participants have to learn more than just a simple stimulus-response relationship. A given behavior (i.e., fuel pellet input) produces different consequences depending upon the current state of the system (i.e., current temperature); therefore, the task can be quite complex and can take a good deal of experience to master. Stanley et al. (1989) compare these task requirements to the skills needed to become an expert at operating complex machinery. The complexity of the task was also expected to allow for a great deal of variability in self-efficacy, effort exertion, and performance, which would enhance the likelihood that the effects of individual difference variables could be detected. Additionally, performance on the task is vague enough to allow for a credible manipulation of feedback.

Measures

Goal orientation. Goal orientation was measured with a scale adapted from VandeWalle's (1997) work-specific goal orientation scale (see Appendix A). The wording of VandeWalle's work-specific scale was slightly modified in order to measure general goal orientation. The 13-item measure contains 3 subscales: (a) 4 items assessing performance-prove goal orientation, (b) 4 items assessing performance-avoid goal orientation, and (c) 5 items assessing learning goal orientation (VandeWalle, 1997). Participants respond to each item on a 6-point Likert-type scale (1=strongly agree; 6=strongly disagree). Internal consistency estimates were .84 for the learning goal orientation scale, .78 for the performance-prove scale, and .80 for the performance-avoid scale.

Performance. Performance for each trial was initially calculated by the computer as the average absolute distance between the reactor temperature and the target of 6000 degrees for the 10 responses. Thus, the closer an individual maintained the reactor temperature to the standard of 6000 degrees, the smaller the absolute distance and the better the performance. For the final performance values, scores were recoded by subtracting a person's true score, or distance from 6000 degrees, from a constant of 6000. The purpose of this recoding was to allow higher scores to be associated with better performance. Performance was measured 120 times (10 performance blocks × 20 trials each).

Self-efficacy. The strength of a participant's self-efficacy for each performance block was assessed with four items similar to those used by Phillips and Gully (1997) and Chen, Gully, Whiteman, and Kilcullen (2000) (See Appendix B). Responses were on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). Scale reliabilities ranged from .76 to .95 across rounds and are reported in the diagonals in Table 1.

Maurer and Pierce (1998) found that Likert-type measures of self-efficacy are an acceptable alternative to traditional measures that separate self-efficacy strength and magnitude. The more traditional measures are much longer and more tedious for the participant, requiring individuals to make multiple estimates about their confidence in their ability to attain several performance levels; therefore a Likert-type measure was chosen for this study.

Intended Effort. The amount of effort that individuals intend to exert on the next performance block was measured with four items similar to those used by VandeWalle et al. (1999) (See Appendix C). Responses were on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). Scale reliabilities ranged from .84 to .98 and are reported in the diagonals in Table 1.

Feedback Manipulation

Individuals were randomly assigned to one of two feedback conditions, where they received either positive or negative feedback after each performance block (with the exception of the final performance block). Specifically, participants were instructed to click on a "Feedback Program" button that purportedly calculated their performance relative to "a normative sample of other university students." In reality, this Feedback Program did not actually calculate their performance but instead presented manipulated positive or negative feedback. All participants received a graphical representation of their normative feedback in addition to a verbal description (See Figures 2 & 3). Presenting the feedback in this fashion was intended to increase the saliency of the positive and negative feedback.

Students in the positive feedback condition received normative feedback following each episode indicating that their performance is better than roughly 90% of all participants. Students in the negative feedback condition received normative feedback indicating that their performance is better than roughly 10% of all participants. Specific percentiles differed slightly for each feedback episode (e.g., 89%, 91%, 88%) in order to appear plausible; however, average feedback across feedback episodes was "better than 90%" for the positive feedback condition and "better than 10%" for the negative feedback condition. A three-item manipulation check was given after each feedback episode and prior to the collection of the dependent variables in order to assess whether

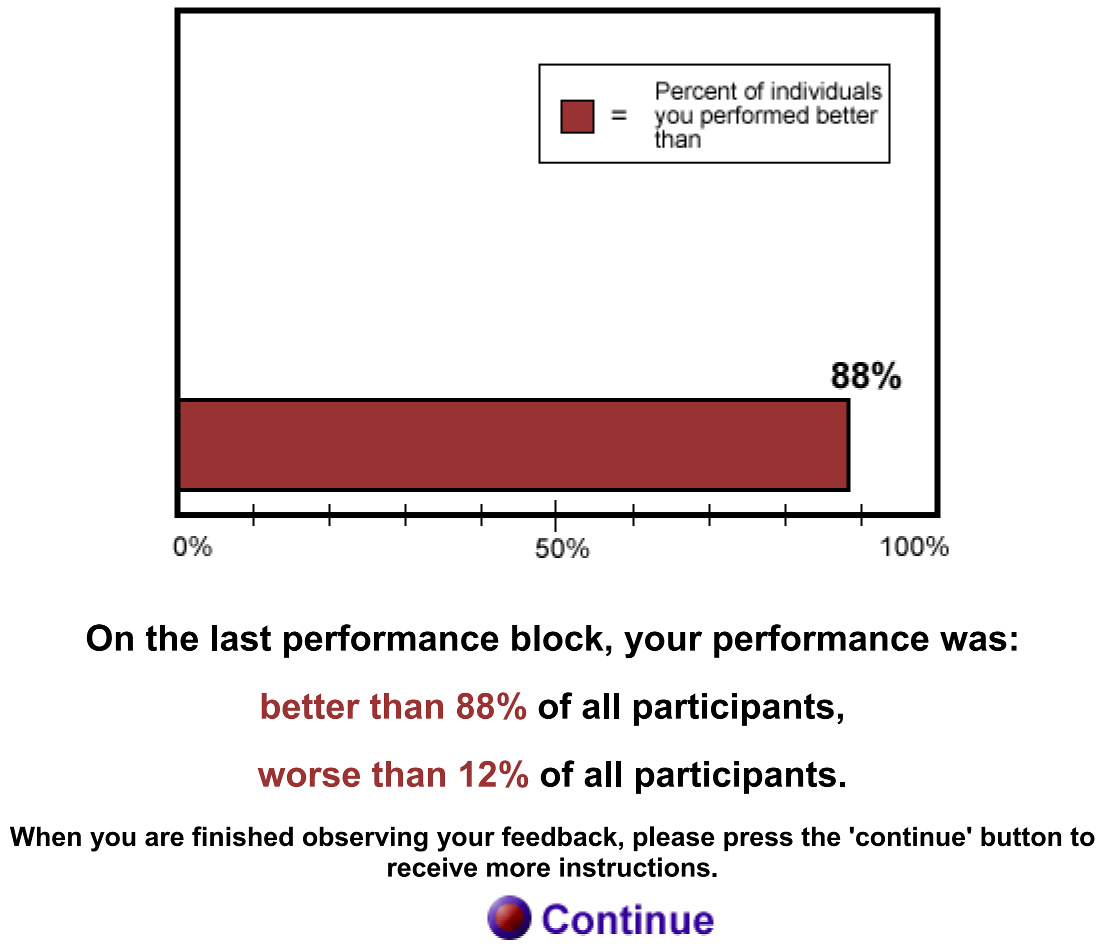
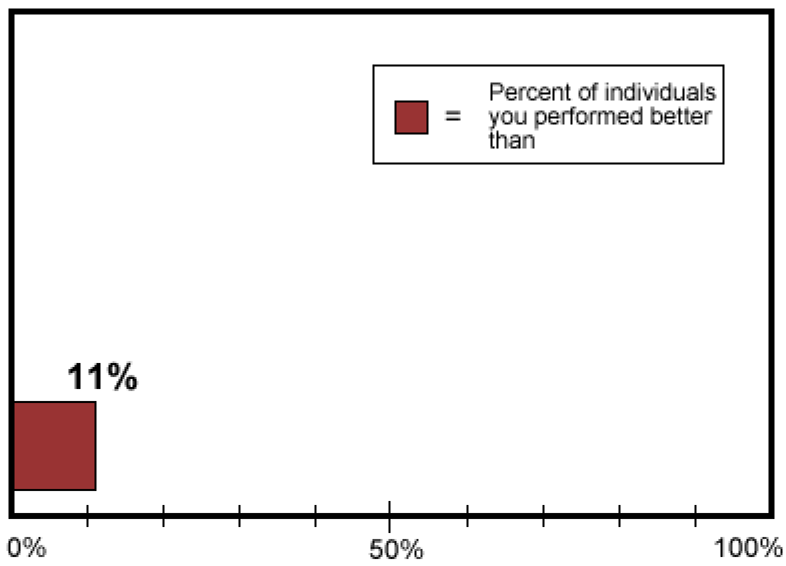


Figure 2. Sample Feedback Screen (Positive Condition)



On the last performance block, your performance was:

better than 11% of all participants,

worse than 89% of all participants.

When you are finished observing your feedback, please press the 'continue' button to receive more instructions.

Continue

Figure 3. Sample Feedback Screen (Negative Feedback Condition)

the feedback was salient to individuals and whether they were in fact interpreting the feedback as intended (See Appendix D).

Procedure

Upon arrival at the experimental session, participants completed the self-report measure of goal orientation. Next, they received videotaped instructions and an introduction to the chemical reactor task, along with the goal of keeping the temperature between 5000-7000 degrees. Pilot work with this task had shown that average performance at this level was attainable by 15% of participants. In addition, results of this study showed that 7.7% of the participants were able to achieve this level of performance. This assignment therefore represented a difficult yet attainable goal, as recommended by Locke and Latham (1990). After receiving instructions, participants performed 10 practice trials to familiarize themselves with the task. Prior to the initial experimental block, participants completed the self-efficacy and intended effort questionnaires. Then they performed the first block, which consisted of 20 trials (screens). After the first experimental block, participants received normative feedback, responded to the manipulation check, and completed self-efficacy and intended effort questionnaires for the next performance block. Participants performed a total of 6 performance blocks. Individuals received manipulated normative feedback and completed the questionnaires following the first 5 blocks. After the final block of trials, participants did not receive any feedback, but instead were debriefed on the nature of the investigation and awarded extra credit. The entire experimental session lasted between 1 to 1.5 hours.

Analytic Strategy

Hierarchical linear modeling (HLM) is a statistical technique for analyzing data that exists at multiple, hierarchically nested levels. Bryk and Raudenbush (1992) note that longitudinal data are implicitly multi-level in nature, with episodes nested within persons; therefore, they recommend hierarchical linear modeling (HLM) for analysis of such data. With longitudinal data, HLM involves first modeling within-person changes in the dependent variable over time, using measurement occasions as the predictor (level 1). A separate regression line is derived for each person, with an intercept and slope. If a curvilinear relationship is present, a quadratic term can be added to the level 1 equation. These level 1 coefficients serve as the dependent variables in the level 2 analyses. The level 2 predictors are any person level variables expected to predict the within person coefficients (Hofmann, Griffin, & Gavin, 2000).

In this study, separate analyses were run for each dependent variable (self-efficacy, effort, and performance). Level 1 consisted of modeling change in the particular dependent variable for each person over time. Level 2 analyses examined whether feedback condition, goal orientation, and the interactions between feedback condition and goal orientation predicted these within-person changes. The sequencing of tests, based on the recommendations of Bryk and Raudenbush (1992), Hofmann, Griffin, and Gavin (2000), and Hofmann (1997), is outlined below.

Assessing the Trend of the Dependent Variable Over Time

In order to model within-person patterns of change with between-person variables, it is first necessary to decide on the proper way to model within-person change. To do this, a null model, with no level-2 predictors, is estimated first. This model determines the amount of between-person variance in the DV. It is conceptually equivalent to a one-way analysis of variance (ANOVA) because it partitions the total variance in the DV into within-person and between-person components. This information is important because the dependent variables in this study are thought to vary as a function of both within-person changes and between-person differences. For these hypotheses to be supported, it is necessary that there be significant variance both within persons and between persons on the DVs. The equations for the null model are as follows:

Level 1: $DV = \beta_{0j} + r_{ij}$ (1)

Level 2: $\beta_{0j} = \gamma_{00} + U_{0j}$ (2)

Where β_{0j} is the DV mean for person j, γ_{00} is the grand mean in the DV, r_{ij} is the within-person variance in the DV, and U_{0j} is the between-person variance in the DV.

Next, a linear model of within-person change is estimated by adding trial number as a level-1 predictor. By comparing this model to the null model, it is possible to estimate the percentage of variance in within-person change attributable to a linear trend with the following equation:

$R^2 = \sigma^2_{null} - \sigma^2_{linear} / \sigma^2_{null}$ (3)

where σ^2_{null} is the percentage of within-person variance in the DV explained by the null model, and σ^2_{linear} is the percentage of within-person variance explained by the linear model.

Finally, a curvilinear model of within-person change is estimated by adding the square of trial number as a second level-1 predictor. By examining the change in R^2 from the linear model to the quadratic model, it is possible to determine whether addition of the quadratic term improves the ability to model within person changes. The variance explained by the quadratic model is calculated with the following equation:

$$R^2 = \sigma^2_{null} - \sigma^2_{quadratic} / \sigma^2_{null} \qquad (4)$$

where σ^2_{null} is the percentage of within-person variance in the DV explained by the null model, and $\sigma^2_{quadratic}$ is the percentage of within-person variance explained by the quadratic model. The change in R^2 can then be calculated by subtracting the R^2 of the linear model from the R^2 of the quadratic model. If the quadratic term is significant, the curvilinear model is used for further analyses. For example, the level-1 equation for a quadratic model of the DV would be as follows:

$$DV = \beta_{0j} + \beta_{1j}\,(\text{Trial number}) + \beta_{2j}\,(\text{Trial number})^2 + r_{ij} \qquad (5)$$

where β_{0j} is the level-1 intercept, β_{1j} is the instantaneous slope at the beginning of Round 1, and β_{2j} is the acceleration rate of the DV. This model, containing all level-1 predictors and no level-2 predictors, is called the unconditional model, or random-coefficient regression model. It provides several relevant preliminary analyses, and is described in further detail below.

Level 1: Unconditional Model

The unconditional model, because it contains no level-2 predictors, provides information on the average values of each parameter across persons and whether these values are significantly different from zero. In addition, it provides chi-square tests that are designed to estimate the extent to which the values of each parameter deviate from the mean. In other words, it tests the null hypothesis that there are no significant differences between persons in the level-1 coefficients (e.g., growth parameters). As previously mentioned, these tests are important because, in order to model individual growth curves in the DV with between-person variables, there must be significant variance in these parameters across persons. If the χ^2 test for a parameter is significant, it indicates that this parameter does significantly differ across persons.

The unconditional model also provides reliability estimates for each parameter. These reliabilities represent the proportion of variance in a parameter that is systematic (that is, the proportion of variance in the parameter that is not due to error). These reliability estimates are important because, if most of the variance in these level-1 parameters is due to model error, it is unlikely to find systematic relations with level-2 predictors (Bryk & Raudenbush, 1992).

Only Hypothesis 9, that performance would improve over time, was directly tested by examining the unconditional model. A significant mean acceleration rate of performance, β_{2j}, would indicate support for Hypothesis 9.

Level-2: Conditional Model

Conditional models in HLM are often called intercepts-as-outcomes models or slopes-as-outcomes models because they model the parameters estimated at level-1 with level-2 predictors. In other words, level-1 within-person parameters are regressed onto level-2 between-person variables.

In this study, Hypotheses 1a-d and 5a-c concerned predicting initial levels of self-efficacy and effort with the dimensions of goal orientation. Therefore, the intercepts-as-outcomes model was used to test these hypotheses. The level-1 intercept estimates were regressed onto each goal orientation dimension (LGO, PPGO, and PAGO) in separate analyses.

Hypotheses 2, 6, and 10 predicted that the feedback manipulation would predict changes in the DV over time; therefore, the slopes-as-outcomes model was used to test these hypotheses. In other words, the level-1 estimates were regressed onto the level-2 feedback variable (dummy coded as 0 = negative feedback condition; 1 = positive condition). Note that, for DVs that were best represented by a quadratic model, this meant regressing the acceleration rate parameter onto the feedback variable.

Average performance was also included in the analyses as a predictor of changes in self-efficacy and effort. This variable was included because of the possibility that true task feedback (how close the reactor temperature was to the goal of 6000 degrees) might impact self-efficacy and effort in addition to the manipulated normative feedback. To control for these effects, average performance was included in the level-2 equations as a covariate.

Hypotheses 3a-c, 4, 7a-c, 8, 11a-c, and 12 all dealt with the moderating effects of goal orientation on the effects of the feedback manipulation. This essentially required testing the interaction of feedback sign and the goal orientation dimensions as predictors of within-person changes. For these analyses, an interaction term was created by calculating the product of goal orientation and the dummy-coded feedback variable. At step 1, the main effects of feedback sign, average performance, and goal orientation were entered. Then, at step 2, the interaction term was added to see if it contributed significantly to prediction.

Results

Correlations between study variables, descriptive statistics, and scale reliabilities are reported in Table 1. Hypotheses were tested using hierarchical linear modeling (HLM). The results of these tests are described below.

Manipulation Check

Note that feedback condition was significantly related to self-efficacy on all post-feedback rounds (Rounds 2-6) and also was significantly related to intended effort on the last three rounds. In addition, the manipulation check items following each round revealed significant differences between groups.

The first manipulation check item asked respondents to report the percentile at which they performed on the preceding round (See Appendix D). For Round 1, the mean for the negative feedback group was 9.88 and the mean for the positive feedback group was 90.34, $t(186) = -406.29$, $p < .001$. For Round 2, the means were 10.15 for the negative group and 89.74 for the positive group, $t(186) = -391.16$, $p < .001$. Following Round 3, the mean for the positive group was 9.83, and the mean for the negative group was 90.06, $t(186) = -376.52$, $p < .001$. The Round 4 means for this item were 10.15 for the negative group and 89.97 for the positive group, $t(184) = -370.61$. Following Round 5, the negative group mean was 10.03 and the positive group mean was 89.94, $t(183) = -412.22$, $p < .001$.

The second manipulation check item asked participants to rate their performance on the last round using a 5-point Likert scale (1 = much worse than average; 5 = much better than average). Following Round 1, the mean response to this question was 1.22

for the negative group and 4.50 for the positive group, t(171) = -42.56, $p < .001$. For Round 2, the negative group's mean response was 1.27 and the positive group's mean response was 4.34, t(172) = -37.95, $p < .001$. The Round 3 mean response to this question was 1.34 for the positive group and 4.44 for the negative group, t(175) = -37.26, $p < .001$. For Round 4, the positive group mean was 1.38 and the negative group mean was 4.34, t(187) = -34.48, $p < .001$. Finally, for Round 5, the mean responses were 1.38 for the negative group and 4.34 for the positive group, t(186) = -34.87, $p < .001$.

The last manipulation check item asked participants to rate their performance compared to others on the same 5-point Likert scale (1 = much worse than average; 5 = much better than average). Round 1 mean responses to this question were 1.22 for the negative group and 4.56 for the positive group, t(174) = -44.43, $p < .001$. After Round 2, the mean responses for the negative group were 1.24 for the negative group and 4.47 for the positive group, t(178) = -43.53, $p < .001$. Round 3 means were 1.26 for the negative group and 4.54 for the positive group, t(174) = -44.47, $p < .001$. Following Round 4, the negative mean was 1.23, and the positive group mean was 4.49, t(170) = -44.95, $p < .001$. Round 5 means were 1.26 for the negative group and 4.51 for the positive group, t(176) = -43.02, $p < .001$.

Self-efficacy Analyses

Assessing the Trend of Self-efficacy over Time

The first step in testing the self-efficacy hypotheses was determining whether a linear or quadratic trend best fit the data. First, a null model (a model with no level-1

Table 1

Descriptives, Scale Reliabilities, and Correlations

	Mean	S. D.	1	2	3	4	5	6	7	8	9	10	11
1. Condition													
2. Self-efficacy 1	2.75	1.05	.08	(.76)									
3. Self-efficacy 2	3.36	1.36	.44**	.56**	(.85)								
4. Self-efficacy 3	3.53	1.51	.56**	.46**	.79**	(.88)							
5. Self-efficacy 4	3.56	1.65	.60**	.33**	.70**	.85**	(.90)						
6. Self-efficacy 5	3.54	1.76	.66**	.29**	.72**	.83**	.85**	(.93)					
7. Self-efficacy 6	3.53	1.88	.68**	.28**	.67**	.82**	.85**	.92**	(.95)				
8. Effort 1	5.91	.81	.02	-.05	-.01	.07	.12	.15*	.18*	(.84)			
9. Effort 2	5.83	.94	.11	-.04	.11	.17*	.20	.22**	.27**	.83**	(.89)		
10. Effort 3	5.78	1.10	.09	.04	.06	.19**	.21**	.22**	.29**	.77**	.81**	(.95)	
11. Effort 4	5.64	1.20	.20**	.07	.17*	.25**	.31**	.32**	.34**	.69**	.78**	.83**	(.91)
12. Effort 5	5.49	1.41	.21**	.00	.17*	.27**	.34**	.33**	.39**	.64**	.70**	.81**	.85**
13. Effort 6	5.40	4.55	.25**	.06	.21*	.29**	.35**	.37**	.44**	.57**	.63**	.73**	.79**
14. Practice	3382.53	398.76	.08	.11	.10	.08	.06	.13	.12	-.04	-.12	-.01	.02
15. Performance 1	3086.92	485.27	.02	.03	.06	.06	.10	.08	.08	-.01	-.02	.06	.13
16. Performance 2	2797.91	573.29	.08	-.14	.05	.13	.22**	.20**	.19*	.03	.00	.07	.16*
17. Performance 3	2638.48	684.89	.10	-.13	.07	.19*	.27**	.25**	.28**	.09	.05	.16*	.22**
18. Performance 4	2484.13	719.59	.01	-.17*	-.02	.12	.18**	.19*	.21**	.16*	.11	.23**	.25**
19. Performance 5	2358.19	743.92	-.01	-.14	-.01	.13	.18*	.20**	.25**	.16*	.13	.26**	.23**
20. Performance 6	2321.01	800.00	.01	-.13	.03	.15*	.18*	.20**	.25**	.18*	.16*	.28**	.25**
21. LGO	4.73	.72	.03	-.04	-.05	-.02	.05	.00	.01	.25**	.25**	.14	.17*
22. PPGO	4.38	.88	-.00	.03	-.08	-.03	-.11	-.02	-.05	.11	.08	.12	.07
23. PAGO	3.35	.90	.03	-.01	.05	-.04	-.08	-.03	-.08	-.06	-.10	-.07	-.08

Table 1 continued

	12	13	14	15	16	17	18	19	20	21	22	23
1. Condition												
2. Self-efficacy 1												
3. Self-efficacy 2												
4. Self-efficacy 3												
5. Self-efficacy 4												
6. Self-efficacy 5												
7. Self-efficacy 6												
8. Effort 1												
9. Effort 2												
10. Effort 3												
11. Effort 4												
12. Effort 5	(.95)											
13. Effort 6	.90**	(.98)										
14. Practice	-.01	-.02	(.55)									
15. Performance 1	.08	.08	.38**	(.83)								
16. Performance 2	.14	.17*	.14	.60**	(.86)							
17. Performance 3	.23**	.25**	.14	.50**	.81**	(.91)						
18. Performance 4	.31**	.30**	.09	.47*	.74**	.86**	(.92)					
19. Performance 5	.32**	.32**	.02	.41**	.65**	.80**	.87**	(.93)				
20. Performance 6	.35**	.34**	.02	.41**	.60**	.74**	.83**	.91**	(.94)			
21. LGO	.17*	.17*	-.08	-.09	-.11	-.01	.00	.02	.02	(.84)		
22. PPGO	.02	.00	-.02	-.11	-.06	-.09	-.00	-.02	.04	.31**	(.78)	
23. PAGO	-.12	-.11	-.00	-.09	-.04	-.07	-.06	-.02	-.03	-.22	.22**	(.80)

Note: Available internal consistency reliabilities are reported in parentheses in the diagonals. * $p < .05$, ** $p < .01$.
Condition is coded as 0 = negative condition; 1 = positive condition.

predictors) was estimated. Then, a linear model was estimated with trial as a level-1 predictor. Comparison of these two models revealed that 45% of the within-person variance in self-efficacy was explained by the linear trial term.

Next, the fit of a curvilinear model of self-efficacy was examined by adding the square of trial number as another level-1 predictor. This term resulted in a .12 change in R^2 from the linear model. This change was significant ($p < .001$), indicating that the quadratic term added significantly to the prediction, resulting in a total R^2 of .57 for the quadratic model. The quadratic model of self-efficacy was therefore adopted for further analyses.

<u>Level 1: Unconditional Model of Self-efficacy</u>

The quadratic model of self-efficacy containing no level-2 predictors, also called the unconditional model, is reported in Table 2. The level-1 equation was as follows:

$$\text{Self-efficacy} = \beta_{0j} + \beta_{1j}(\text{Trial number}) + \beta_{2j}(\text{Trial number})^2 + r_{ij} \qquad (6)$$

where β_{0j} is the level-1 intercept, β_{1j} is the instantaneous slope at the beginning of Round 1, β_{2j} is the acceleration rate of self-efficacy, and r_{ij} is the level-1 error term.

The top of Table 2 reports the fixed effects results for the unconditional model. The mean intercept, $\beta_{00,}$ was 2.79 on a scale of 1-7, indicating that individuals began Round 1 reporting an average self-efficacy of 2.79. This value is slightly below the midpoint of the scale, suggesting that individuals reported somewhat low self-efficacy at the beginning of the task. The mean initial slope of self-efficacy, β_{10}, was .49, indicating that, at the beginning of Round 1 (after the practice round), the average rate of change in self-efficacy was almost half a point per trial.

Table 2

Results of Hierarchical Linear Modeling Analysis—Unconditional Model: Self-Efficacy (SE) as Dependent Variable

Fixed effects	*Coefficient*	*Standard Error*	*t*	*p*
Mean initial SE, β_{00}	2.79	.08	34.57	.000
Mean initial SE trend, β_{10}	.49	.07	7.37	.000
Mean SE acceleration, β_{20}	-.07	.01	-7.20	.000
Random effects	*Variance Component*	*df*	χ^2	*p*
Initial SE, r_{0i}	.80	170	590.95	.000
Initial SE trend, r_{1i}	.46	170	439.74	.000
SE acceleration, r_{2i}	.01	170	280.31	.000
Level-1 error, e_{ti}	.39			
Reliability of OLS estimates				
Initial SE, β_{0i}	.71			
Initial SE trend, β_{1i}	.61			
SE Acceleration, β_{2i}	.37			

Finally, the mean self-efficacy acceleration, $\beta_{20,}$ was -.07. The negative acceleration term indicates that the average person's self-efficacy curve was slightly convex downward, meaning that it increased over time, but leveled off toward the end of the session. Note also that the significant t-ratios for each term indicate that each parameter is necessary for describing the mean individual trend in self-efficacy.

The variance components for the random effects are reported in the bottom portion of Table 2. All three χ^2 tests were significant, indicating that there were differences between participants in initial self-efficacy, initial self-efficacy slope, and self-efficacy acceleration.

Reliabilities for each parameter are reported in the bottom of Table 2. They were .71, .61, and .37, for initial self-efficacy, initial self-efficacy slope, and self-efficacy acceleration, respectively.

Level-2: Conditional Models of Self-efficacy

Results for the conditional models of self-efficacy are reported in Table 3. These are the analyses that provide the tests of the hypotheses in this study. The level-2 equations modeled the slope across participants and were as follows:

$$\beta_{0j} = \gamma_0(\text{Goal orientation}) + u_j \tag{7}$$

$$\beta_{2j}\ (\text{Step 1}) = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + \gamma_3(\text{Average performance}) + u_j \tag{8}$$

$$\beta_{2j}\ (\text{Step 2}) = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + \gamma_3(\text{Average performance})$$

$$+ \gamma_4(\text{Feedback x Goal orientation}) + u_j \qquad (9)$$

where γ_0 represents the level-2 intercept, γ_1, γ_2, γ_3, and γ_4 represent the level-2 predictor slopes, and u_j is the level-2 error term in the slope.

LGO, PPGO, and PAGO (each represented as γ_{01} in their respective parts of the table) were not significant predictors of initial self-efficacy. Therefore, hypotheses 1a-1c were not supported. Consequently, Hypothesis 1d, which predicted that PAGO would have a stronger negative relationship with initial self-efficacy than PPGO, was not supported.

Hypothesis 2 predicted that feedback sign would have a main effect on the change in self-efficacy over trials, such that positive feedback would be associated with increased self-efficacy over time and negative feedback would be associated with decreased self-efficacy over time. For a quadratic model, this meant modeling the acceleration term with the feedback predictor. In support of Hypothesis 2, for each goal orientation model, the step 1 coefficient for condition (coded 0 = negative condition; 1 = positive condition) was significant ($p < .001$) and positive. Figure 4 illustrates the average self-efficacy trend for the positive and negative conditions. Specifically, the average self-efficacy curve in the positive condition had an intercept of 2.99, an average initial slope of .95, and an average acceleration of -.12 (all terms significant at $p < .001$). The average self-efficacy curve in the negative condition had an intercept of 2.65 ($p < .001$), a non-significant initial slope ($\beta_{1j} = .06$, n.s.), and an average acceleration of -.03 ($p < .05$). These results indicate that self-efficacy increased quickly in the positive

Table 3

Results of Hierarchical Linear Modeling Analysis—Conditional Models of Self-Efficacy (SE)

LGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. at Step 1*	*Coefficient at Step 2*	*S.E. at Step 2*
	Model for initial SE, β_{0i}				
	Intercept, γ_{00}	2.81494***	.07996		
	LGO, γ_{01}	-.06005	.10954		
	Model for initial SE trend, β_{1i}				
	Intercept, γ_{10}	.48987***	.06537	.48967***	.06536
	Model for SE acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.07233***	.01115	-.07229***	.01107
	Condition, γ_{21}	.06053***	.00647	.15350**	.04332
	LGO, γ_{22}	.00106	.00458	.00120	.00452
	Average Performance, γ_{23}	-.00003***	.00001	-.00003	.00001
Step 2:	LGO x condition, γ_{24}	-	-	-.01991*	.00908
PPGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial SE, β_{0i}				
	Intercept, γ_{00}	2.81554***	.08004		
	PPGO, γ_{01}	.00099	.08869		
	Model for initial SE trend, β_{1i}				
	Intercept, γ_{10}	.48989***	.06537	.48994***	.06537
	Model for SE acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.07237***	.01114	-.07241***	.01113
	Condition, γ_{21}	.06046***	.00647	.07139*	.03392
	PPGO, γ_{22}	.00126	.00371	.00107	.00377
	Average Performance, γ_{23}	-.00002***	.00001	-.00002***	.00001
Step 2:	PPGO x condition, γ_{24}	-	-	-.00253	.00757
PAGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial SE, β_{0i}				
	Intercept, γ_{00}	2.81570***	.08003		
	PAGO, γ_{01}	-.01537	.08676		
	Model for initial SE trend, β_{1i}				
	Intercept, γ_{10}	.48941***	.06536	.48937***	.06538
	Model for SE acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.07212***	.01115	-.07224***	.01114
	Condition, γ_{21}	.06114***	.00642	.03202	.02480
	PAGO, γ_{22}	-.00566	.00354	-.00537	.00354
	Average Performance, γ_{23}	-.00002***	.00001	-.00002***	.00001
Step 2:	PAGO x condition, γ_{24}	-	-	.00859	.00709

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

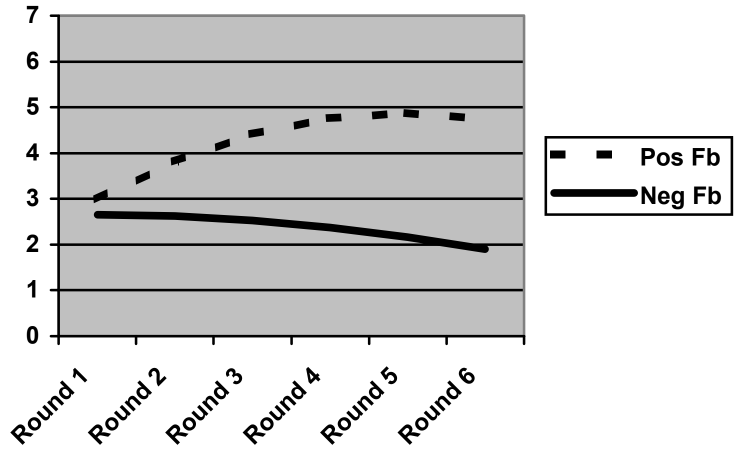


Figure 4. Average self-efficacy trend by condition.

feedback condition and leveled off over time, whereas self-efficacy in the negative feedback condition started off somewhat constant then decreased slowly over time.

Note that, as noted in the analytic strategy section, overall performance was included in the analyses to control for its effects. This was based on the idea that true task feedback (in addition to the manipulated normative feedback) might have an effect on individual's self-efficacy perceptions. Overall performance was found to be a significant predictor of self-efficacy acceleration (See Table 3), and therefore remained in the equations in further analyses.

The tests for hypotheses 3a-3c (that the goal orientations would moderate the effects of feedback sign on changes in self-efficacy) required addition of the product of feedback x goal orientation dimension at step 2. This term was negative and significant for LGO x condition ($\gamma_{24} = -.02$, $p < .05$), suggesting that the higher an individual is in

LGO, the less feedback sign effects changes in self-efficacy. However, this interaction only explained 1.24% of the variance in within-person self-efficacy change. See Figure 5 for a graph of the interaction. The product term was not significant for the PPGO or PAGO models. Therefore, Hypothesis 3c was supported, but hypotheses 3a and 3b were not. Consequently, Hypothesis 4, comparing the moderating effects of PPGO and PAGO, was also not supported.

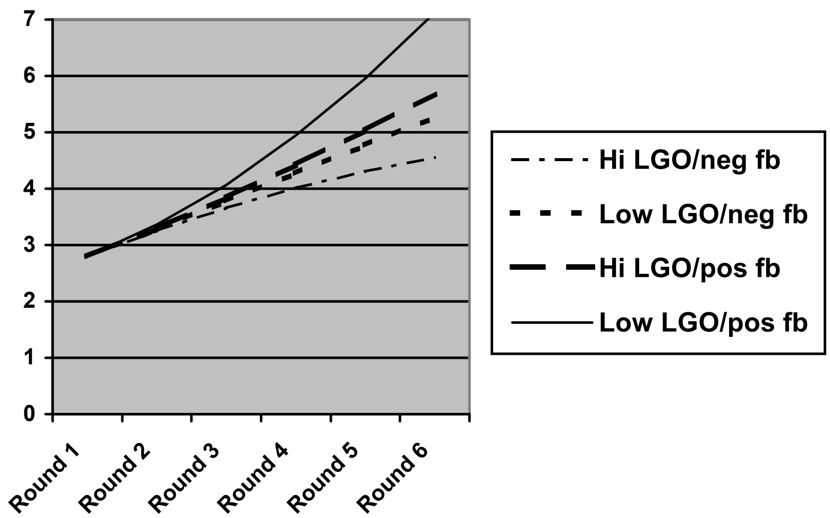


Figure 5. Interaction of LGO and feedback sign on self-efficacy change. Hi LGO represents an LGO equal to 1 S.D. above the mean. Low LGO represents an LGO equal to 1 S.D. below the mean.

Effort Analyses

Assessing the Trend of Effort Over Time

As in the self-efficacy analyses, the first step of the effort analyses required an examination of the effort trend. By comparing the null model and the linear unconditional model of effort, it was determined that 54.17% of the within-person variance in effort was explained by the linear trial term. Upon estimating a quadratic unconditional model of effort, however, the squared trial term was not significant, and the quadratic model did not explain significantly more variance than the linear model. Therefore, a linear model of change in effort was used in further analyses.

Level 1: Unconditional Model of Effort

The results of the unconditional model of effort are reported in Table 4. The level-1 equation was as follows:

$$\text{Effort} = \beta_{0j} + \beta_{1j}(\text{Trial number}) + r_{ij} \qquad (10)$$

where β_{0j} is the level-1 intercept, β_{1j} is the level-1 slope, and r_{ij} is the level-1 error term. Fixed effects results revealed that the mean initial effort (or effort intercept) was 5.96 on a scale of 1-7, meaning that the average participant reported plans to exert quite a bit of effort during round 1. The mean slope in effort was -.12, meaning that the average participant reported decreasing planned effort a little over 1/10 of a point per trial.

Random effects results revealed that individuals differed significantly in their initial planned effort (χ^2 = 1015.37, $p < .001$) and in their rate of change in planned effort (χ^2 = 944.92, $p < .001$), indicating that both of these parameters could be modeled at level 2.

Table 4

Results of Hierarchical Linear Modeling Analysis—Unconditional Model: Effort as Dependent Variable

Fixed effects	*Coefficient*	*Standard Error*	*t*	*p*
Mean initial effort, β_{00}	5.96	.06	95.73	.000
Mean effort trend, β_{10}	-.12	.02	-5.66	.000
Random effects	*Variance Component*	*df*	χ^2	*p*
Initial effort, r_{0i}	.57	173	1015.37	.000
Effort trend, r_{1i}	.06	173	944.92	.000
Level-1 error, e_{ti}	.22			
Reliability of OLS estimates				
Initial effort, β_{0i}	.83			
Effort trend, β_{1i}	.81			

Reliability estimates for effort intercept and slope were .83 and .81, respectively. This indicates that 83% of the variance in effort intercept and 81% of the variance in effort slope is systematic and therefore available for modeling at level-2.

Level 2: Conditional Models of Effort

Results for the conditional models of effort are reported in Table 5. The level-2 equations modeled the slope across participants and were as follows:

$$\beta_{0j} = \gamma_0(\text{Goal orientation}) + u_j \tag{11}$$

$$\beta_{1j}\ (\text{Step 1}) = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + \gamma_3(\text{Average performance}) + u_j \tag{12}$$

$$\beta_{1j}\ (\text{Step 2}) = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + \gamma_3(\text{Average performance}) + \gamma_4(\text{Feedback x Goal orientation}) + u_j \tag{13}$$

where γ_0 represents the level-2 intercept, γ_1, γ_2, γ_3, and γ_4 represent the level-2 predictor slopes, and u_j is the level-2 error term in the slope. Consistent with hypotheses 5a, LGO was a significant predictor of initial planned effort ($\gamma_{01} = .30$, $p < .01$). PPGO was also a significant predictor of the effort intercept ($\gamma_{01} = .14$, $p < .05$), supporting Hypothesis 5b. On the other hand, PAGO was not significantly related to initial planned effort; therefore, support was not found for Hypothesis 5c.

Hypothesis 6 predicted that feedback sign would have a negative effect on changes in effort, such that positive feedback would be associated with decreased effort, and negative feedback would be associated with increased effort. Contrary to what was

Table 5

Results of Hierarchical Linear Modeling Analysis—Conditional Models of Effort

LGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. at Step 1*	*Coefficient at Step 2*	*S.E. at Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.93804***	.06047		
	LGO, γ_{01}	.30263**	.08510		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11454***	.01873	-.11454***	.01877
	Condition, γ_{11}	.14671***	.03725	.04136	.25170
	LGO, γ_{12}	.03124	.02622	.03071	.02630
	Average performance, γ_{13}	-.00014***	.00003	-.00137***	.00003
Step 2:	LGO x condition, γ_{14}	-	-	.02234	.05278
PPGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.96211***	.06179		
	PPGO, γ_{01}	.13999*	.07045		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11460***	.01874	-.11420***	.01873
	Condition, γ_{11}	.14632***	.03738	-.08067	.19470
	PPGO, γ_{12}	-.00990	.02140	-.00561	.02166
	Average performance, γ_{13}	-.00014***	.00003	-.00014***	.00003
Step 2:	PPGO x condition, γ_{14}	-	-	.05166	.04348
PAGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.96560***	.06237		
	PAGO, γ_{01}	-.06553	.06950		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11428***	.01867	-.11434***	.01873
	Condition, γ_{11}	.14851***	.03721	.13295	.14528
	PAGO, γ_{12}	-.02961	.02070	-.02945	.02081
	Average performance, γ_{13}	-.00135***	.00032	-.00014***	.00003
Step 2:	PAGO x condition, γ_{14}	-	-	.00461	.04165

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

predicted, feedback condition actually was found to be positively related to the slope of effort ($\gamma_{11} = .15$, $p < .001$). Specifically, the mean effort slope for individuals in the negative condition was significant and negative ($\gamma_{11} = -.19$, $p < .001$), whereas the mean effort slope for individuals in the positive condition was not significant ($\gamma_{11} = -.04$, n.s.). Feedback condition explained 9.4% of the variance in effort slope. Figure 6 provides a graph of the average effort trend for the positive and negative conditions.

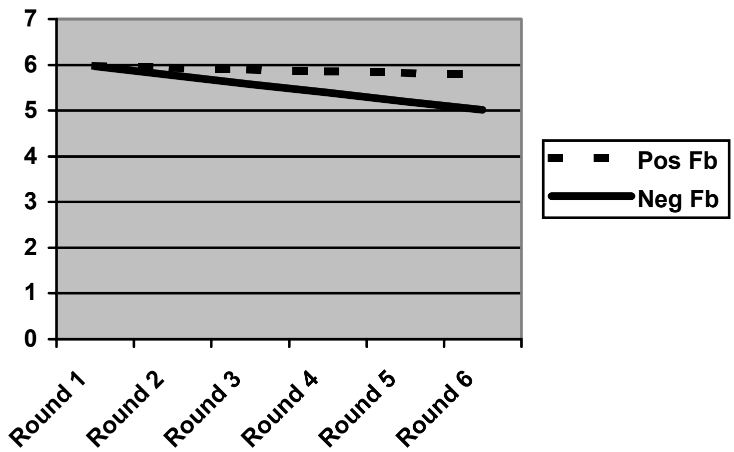


Figure 6. Average effort trend by condition

As in the self-efficacy analyses, there was concern about the effects of true performance on the reactor task affecting intended effort. Average performance was in fact a significant, negative predictor of effort change (See Table 5), such that lower average performance lead to steeper decreases in effort. Therefore, average performance was included as a covariate in further analyses.

Table 5

Results of Hierarchical Linear Modeling Analysis—Conditional Models of Effort

LGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. at Step 1*	*Coefficient at Step 2*	*S.E. at Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.93804***	.06047		
	LGO, γ_{01}	.30263**	.08510		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11454***	.01873	-.11454***	.01877
	Condition, γ_{11}	.14671***	.03725	.04136	.25170
	LGO, γ_{12}	.03124	.02622	.03071	.02630
	Average performance, γ_{13}	-.00014***	.00003	-.00137***	.00003
Step 2:	LGO x condition, γ_{14}	-	-	.02234	.05278
PPGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.96211***	.06179		
	PPGO, γ_{01}	.13999*	.07045		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11460***	.01874	-.11420***	.01873
	Condition, γ_{11}	.14632***	.03738	-.08067	.19470
	PPGO, γ_{12}	-.00990	.02140	-.00561	.02166
	Average performance, γ_{13}	-.00014***	.00003	-.00014***	.00003
Step 2:	PPGO x condition, γ_{14}	-	-	.05166	.04348
PAGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for initial effort, β_{0i}				
	Intercept, γ_{00}	5.96560***	.06237		
	PAGO, γ_{01}	-.06553	.06950		
	Model for effort trend, β_{1i}				
Step 1:	Intercept, γ_{10}	-.11428***	.01867	-.11434***	.01873
	Condition, γ_{11}	.14851***	.03721	.13295	.14528
	PAGO, γ_{12}	-.02961	.02070	-.02945	.02081
	Average performance, γ_{13}	-.00135***	.00032	-.00014***	.00003
Step 2:	PAGO x condition, γ_{14}	-	-	.00461	.04165

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

The moderating effects of goal orientation on the effects of feedback sign (hypotheses 7a-7c) were examined at step 2 by entering the product terms of the goal orientation dimension x feedback sign (dummy coded as 0 = negative feedback; 1 = positive feedback). Surprisingly, none of these product terms were significant; therefore hypotheses 7a-7c were not supported, and Hypothesis 8 comparing the magnitude of moderating effects of PPGO and PAGO was not supported.

Performance Analyses

Assessing the Trend of Performance Over Time

To assess the trend of performance over time, a null model and linear model of performance were estimated, as in the self-efficacy and effort analyses. Comparison of these models revealed that 12.96% of the within-person variance in performance was explained by the linear trial term. Next, a quadratic model was estimated by adding the squared trial term as a predictor. This term explained an additional 2.63% of the within-person variance in performance and was significant ($p < .001$). However, χ^2 tests of random effects revealed that there was no significant between person variance in this parameter ($\chi^2 = 3.73$, n.s.); therefore, it was not possible to model this parameter with the level-2 variables. In addition, both the trial term and the squared trial term had very low reliabilities (These reliability estimates were .007 and .000, respectively). The implications of such low reliability are that there was no reliable within-person variability in performance to be predicted by between-person variables.

Because the low reliability of the linear and quadratic term could likely be due to high multicollinearity between the predictors, the performance analyses were run again, this time using the centering procedures recommended by Bryk and Raudenbush (1992).

In essence, the effects of multicollinearity between the trial term and the squared trial term can be greatly reduced by centering trial number around its mean (trial 60) prior to calculating the quadratic term. In addition, the squared term was also centered for each individual. As expected, this centering procedure improved the reliabilities of the linear and quadratic terms. Therefore, the subsequent performance analyses are based on a quadratic model of performance, with trial and squared trial terms centered. Table 6 reports the unconditional model from the original analyses, and Table 7 reports the centered unconditional model analyses discussed below.

Level 1: Unconditional Model of Performance

The level-1 equation for the performance analyses was as follows:

$$\text{Performance} = \beta_{0j} + \beta_{1j}(\text{Trial number}) + \beta_{2j}(\text{Trial number})^2 + r_{ij} \quad (14)$$

Note that this equation is interpreted somewhat differently because of the centering of trial number at Trial 60. In this case, β_{0j} represents the average performance at Trial 60, and β_{1j} is the instantaneous slope at Trial 60. Finally, β_{2j} is the acceleration rate of performance, and r_{ij} is still the level-1 error term. Although the particular interpretation of the values is not as meaningful using the centered terms, the tests of significance and variance accounted for are meaningful.

Examination of Table 7 reveals that the mean performance at Trial 60 was 3371.82. Because performance was recoded by subtracting a person's true score from a constant of 6000, the average performance of 3371.82 indicates that individuals scored an average of 2628.18 degrees away from the goal of 6000 degrees at Trial 60.

Table 6

Results of Hierarchical Linear Modeling Analysis—Unconditional Model for Original (Uncentered) Performance Analyses

Fixed effects	*Coefficient*	*Standard Error*	*t*	*p*
Mean initial performance, β_{00}	2786.53	39.74	80.86	.000
Mean initial performance trend, β_{10}	14.57	1.54	-9.44	.000
Mean performance acceleration, β_{20}	.06	.01	5.15	.000
Random effects	*Variance Component*	*df*	χ^2	*p*
Initial performance, r_{0i}	218979.27	3	2.84	>.500
Initial performance trend, r_{1i}	324.32	3	2.37	>.500
Performance acceleration, r_{2i}	.02	3	3.73	.292
Level-1 error, e_{ti}	822408.98			
Reliability of OLS estimates				
Initial performance, β_{0i}	.231			
Initial performance trend, β_{1i}	.007			
Performance acceleration, β_{2i}	.000			

Table 7

Results of Hierarchical Linear Modeling Analysis—Unconditional Model: Performance as Dependent Variable (Centered Analyses)

Fixed effects	*Coefficient*	*Standard Error*	*t*	*p*
Mean performance (at Trial 60), β_{00}	3371.82	43.21	78.04	.000
Mean performance trend (at Trial 60), β_{10}	7.48	.5524	13.54	.000
Mean performance acceleration, β_{20}	-.06	.0113	-5.09	.000
Random effects	*Variance Component*	*df*	χ^2	*p*
Initial performance, r_{0i}	327856.87	4	250.24	.000
Initial performance trend, r_{1i}	47.58	4	23.50	.000
Performance acceleration, r_{2i}	.02	4	20.07	.001
Level-1 error, e_{ti}	906.86			
Reliability of OLS estimates				
Initial performance, β_{0i}	.97			
Initial performance trend, β_{1i}	.77			
Performance acceleration, β_{2i}	.54			

The average instantaneous rate of change in performance at Trial 60 was 7.48, indicating that, at Trial 60, individuals were getting almost seven-and-one-half points closer to the goal per trial. Finally, the average acceleration in performance was -.06, which indicates a learning curve that is convex downward. This means that individuals' performance improved but began to level off over time. This trend is consistent with the power law of practice (Anderson, 1990; Eyring et al., 1993), which states that learning rates become slower as individuals approach asymptotic performance. These findings provide support for Hypothesis 9 (that performance would improve over trials). Figure 7 illustrates the average trend of performance over time, based on the parameters of the unconditional model.

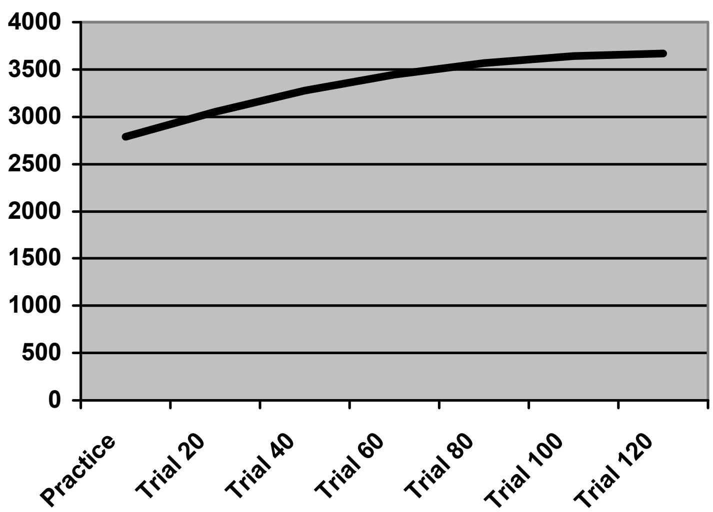


Figure 7. Average performance trend over time.

According to the random effects results, individuals differed significantly in their average performance at Trial 60 (χ^2 = 250.24, $p < .001$), in their rate of change at Trial 60 (χ^2 = 23.50, $p < .001$), and in their acceleration of performance (χ^2 = 20.07, $p = .001$), indicating that these parameters could be modeled at level 2.

Reliability estimates of the level-1 coefficients were .98, .77, and .54 for the intercept, trial number, and squared trial terms, respectively. This indicated that 98% of the variance in intercept, 77% of the variance in Trial 60 slope, and 54 % of the variance in the acceleration term were available for modeling in level-2.

<u>Level-2: Conditional Models of Performance</u>

Results for the conditional models of performance are reported in Table 8. The level-2 equations were as follows:

$$\beta_{2j} \text{ (Step 1)} = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + u_j \quad (15)$$

$$\beta_{2j} \text{ (Step 2)} = \gamma_0 + \gamma_1(\text{Feedback}) + \gamma_2(\text{Goal orientation}) + \gamma_3(\text{Feedback x Goal orientation}) + u_j \quad (16)$$

where γ_0 represents the level-2 intercept, γ_1 , γ_2 , and γ_3 represent the level-2 predictor slopes, and u_j is the level-2 error term in the slope.

Surprisingly, feedback condition was not a significant predictor of acceleration in performance. Therefore, Hypotheses 10 was not supported. In addition, examination of the product terms in Step 2 of each analyses shows that none of these product terms were significant, failing to support Hypotheses 11a-11c. Consequently, Hypothesis 12, which predicted that PAGO would be a stronger moderator of the effects of feedback sign than PPGO, was not supported.

Table 8

Results of Hierarchical Linear Modeling Analysis—Conditional Models of Performance (Centered at Trial 60)

LGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. at Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for performance at Trial 60, β_{0i}				
	Intercept, γ_{00}	3371.81***	43.21	3371.82***	43.21
	Model for instantaneous performance trend at Trial 60, β_{1i}				
	Intercept, γ_{10}	7.48***	.55	7.48***	.55
	Model for performance acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.05764***	.01119	-.05764***	.01119
	Condition, γ_{21}	-.01308	.02074	-.04985	.13762
	LGO, γ_{22}	-.01523	.01397	-.01543	.01408
Step 2:	LGO x condition, γ_{23}	-	-	.00781	.02803
PPGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for performance at Trial 60, β_{0i}				
	Intercept, γ_{00}	3371.82***	43.21	3371.82***	43.21
	Model for instantaneous performance trend at Trial 60, β_{1i}				
	Intercept, γ_{10}	7.48***	.55	7.48***	.55
	Model for performance acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.05759***	.01123	-.05747***	.01120
	Condition, γ_{21}	-.01326	.02077	-.10652	.11019
	PPGO, γ_{22}	.00288	.01221	.00461	.01216
Step 2:	PPGO x condition, γ_{23}	-	-	.02124	.02439
PAGO	*Fixed Effects*	*Coefficient at Step 1*	*S.E. Step 1*	*Coefficient at Step 2*	*S.E. Step 2*
	Model for performance at Trial 60, β_{0i}				
	Intercept, γ_{00}	3371.82***	43.21	3371.81***	43.21
	Model for instantaneous performance trend at Trial 60, β_{1i}				
	Intercept, γ_{10}	7.48***	.55	7.48***	.55
	Model for performance acceleration, β_{2i}				
Step 1:	Intercept, γ_{20}	-.05757***	.01120	-.05739***	.01125
	Condition, γ_{21}	-.01342	.02091	.02241	.06972
	PAGO, γ_{22}	.00190	.01054	.00148	.01036
Step 2:	PAGO x condition, γ_{23}	-	-	-.01061	.02064

Discussion

The purpose of this investigation was to study the effect of feedback sign on changes in self-efficacy, effort, and performance over the course of a learning task and to examine the dimensions of goal orientation as moderators of those effects.

Self-efficacy Findings

One surprising finding was that, contrary to previous research (e.g., Diefendorff, 2002; Phillips & Gully, 1997), none of the dimensions of goal orientation were significant predictors of initial self-efficacy. Goal orientation was expected to predict initial self-efficacy because if its foundation in implicit theories of ability (Kanfer, 1990). Self-efficacy, however, is a complex judgment based on many factors, including causal attributions for performance (Gist & Mitchell, 1992). Thomas and Mathieu (1994) noted that the impact of causal attributions is greatest when participants have little previous experience with the task or when the outcome is unexpected (such as in the case of failure). They found that causal attributions for performance moderated the relationship between goal achievement and satisfaction following students' first exam of the semester. Specifically, performance had a weak relationship with satisfaction for those who attributed performance to external agents but a strong relationship with satisfaction for those who attributed performance to an internal locus. In the case of the reactor control task, initial performance (during the practice round) involved a great deal of trial and error; therefore, it is likely that participants attributed their performance to guesswork or luck. Consequently, it could be that implicit theories of ability, and therefore goal orientation, did not influence initial self-efficacy estimates because participants felt that ability was not a factor in such a "guessing game."

As hypothesized, feedback sign did predict changes in self-efficacy over time. This finding is consistent with previous research; in fact, numerous investigations have used false normative feedback as a manipulation of self-efficacy (Bandura & Locke, in press). The question of main interest, however, was whether the individual difference variable of goal orientation would moderate the effects of feedback sign. These results were somewhat disappointing in that PPGO and PAGO were not significant moderators of the effects of feedback on changes in self-efficacy. LGO, on the other hand, did moderate the effects of feedback on changes in self-efficacy, such that the changes in self-efficacy of individuals high in LGO were less affected by the sign of feedback than the changes in self-efficacy of those low in LGO. It could be that individuals' reactions to feedback (in terms of how it affects their self-efficacy) are influenced more by how much they focus on mastering tasks (LGO), and not by how much they focus on proving their abilities to others (PPGO and PAGO). Another possible explanation, however, is that both foci have some effect on changes in self-efficacy after feedback, but this investigation simply did not have the statistical power to detect the cross-level interactions between feedback sign and PPGO and PAGO. Power considerations will be discussed further in the limitations section.

The interaction between LGO and feedback sign on self-efficacy change is illustrated in Figure 5. Although individuals began the task with similar levels of self-efficacy, the lines representing self-efficacy change in individuals receiving positive versus negative feedback diverge to a greater extent for those low in LGO than for those high in LGO.   Note that individuals low in LGO increased their self-efficacy a great deal in response to positive feedback, whereas individuals high in LGO were not as affected by the positive feedback. This is consistent with the idea that individuals high in LGO are more concerned with mastering a task than with how they are doing compared to others (normative feedback). Surprisingly, however, individuals high in LGO who received negative feedback had the smallest increase in self-efficacy. It is unclear why individuals low in LGO who received negative feedback didn't have the smallest increase in self-efficacy. Theoretically, these individuals should have been the most influenced by positive and negative feedback, but this was not the case. Future research should consider this issue in more detail.

It is also interesting to note that none of the dimensions of goal orientation had significant main effects on changes in self-efficacy. In fact, none of the dimensions of goal orientation were significantly correlated with reported self-efficacy on any of the rounds (See Table 1). It seems that self-efficacy, at least for this type of task, is not influenced by individuals' general tendencies to approach tasks as learning, proving, or avoidance situations. Again, given the foundation of goal orientation in implicit theories of ability, this lack of a relationship is surprising. However, as mentioned above, the inability to predict changes in self-efficacy may be due, in part, to the many other factors that influence these judgments (Gist & Mitchell, 1992), especially on complex tasks such as the one used in this study.

Effort Findings

As hypothesized, LGO and PPGO were both significant predictors of initial effort on the chemical reactor task. These findings are consistent with the idea that individuals high in LGO view effort as a means for gaining mastery on a task and therefore approach learning situations with more effort than those low in LGO. In addition, individuals high in PPGO are believed to view learning situations as a chance to prove their competence to others; therefore, it is not surprising that they exert more effort than those low in PPGO upon approaching a learning opportunity.

Contrary to what was hypothesized, however, PAGO did not predict initial effort. It was thought that because individuals high in PAGO view effort as a sign of low ability, they would not want to exert (or at least report exerting) a great deal of effort on the reactor task, for fear of exhibiting low competence. However, demand characteristics of the task may have biased self-report of effort in these cases so that individuals high on PAGO were likely to report intention to exert effort similar to that of individuals low on PAGO. In other words, in most settings, individuals high in PAGO shy away from reporting a great deal of effort because they view effort as indicative of low ability. However, in this situation, they may have seen it as socially undesirable to report low effort because of the laboratory setting. Perhaps one of the most surprising findings was the effect of feedback sign on changes in effort. In accordance with control theory, it was hypothesized that feedback sign would affect the direction of effort change, such that positive feedback would be associated with decreasing effort, and negative feedback would be associated with increasing effort. Whereas the effect of feedback was in fact significant, it was in the opposite direction.

Upon examining the slopes by condition, it was found that effort decreased over trials in the negative condition, and did not significantly change in the positive condition (See Figure 6). Control theory does in fact predict that when individuals receive positive feedback they should either (a) decrease effort or (b) sustain current effort; therefore, the trend found in the positive condition (that participants sustained their current effort) was not surprising. However, control theory would predict that individuals in the negative condition would increase effort upon receiving feedback. One possible explanation for these findings is that individuals who received negative normative feedback grew quickly frustrated with the already difficult task and abandoned the goal. According to control theory, discrepancies between goals and current perceived states can be reduced by putting forth more effort, or by changing or abandoning the goal (Carver & Scheier, 1998). In this case, the manipulated negative feedback might have quickly caused attention to be redirected to the self level and individuals may have decided to abandon the goal in order to reduce the discrepancy between the goal and perceived performance. By abandoning the goal, the discrepancy between the goal and perceived performance would have been reduced, causing individuals to put forth less effort.

Another way to explain these findings is by appealing to the concept of a goal hierarchy. Because the task used in this study is a learning task, the goal of keeping the temperature between 5000 and 7000 degrees might be viewed as a subordinate goal to the higher-order goal of learning the underlying pattern. If learning the pattern represents an individual's superordinate goal, it would be expected that he should continue to put forth effort only as long he sees a chance for achieving this goal (Kluger & DiNisi, 1996). It could be that the trial and error nature of the learning task, coupled with the receipt of negative normative feedback, resulted in participants not believing there was a chance to obtain this superordinate goal. As a result, they may have reduced their effort toward the subordinate goal (maintaining the temperature).

Another surprising finding in this study was the fact that none of the dimensions of goal orientation moderated the effects of feedback on changes in effort. These results are quite unexpected given the substantial theoretical and empirical support for these hypotheses (e.g., Dweck & Leggett, 1988; Kluger & DiNisi, 1996). One explanation for this lack of findings might be low power to detect cross-level effects as mentioned previously. However, another possible explanation is that the feedback sign affected all individuals similarly, regardless of their levels of goal orientations. This explanation makes sense if one assumes that all individuals (regardless of goal orientation) held the same superordinate goal of learning the pattern, and that the manipulated feedback they received was interpreted as information concerning whether or not this goal was possible. It is impossible to tell from the data collected in this study whether or not this was the case; however, feedback sign only accounted for 9.4% of the variance in effort change, indicating that there was quite a bit of variance left to be explained by other variables.

Performance Findings

The results obtained from the performance hypotheses were also surprising. Although there was a great deal of variability in the performance curves, neither feedback condition, nor goal orientation, nor any of the goal orientation by feedback interactions were significant predictors of performance change. It could be that the task was too complex, such that performance on it could only be predicted by ability factors, rather than motivational factors. However, the only proxy for ability obtained in this study, self-reported grade point average, was also not a significant predictor of improvement. This result might lead one to conclude that the task used in this experiment might not have been the most appropriate for assessing predictors of learning. This possibility will be discussed in the following section.

Limitations and Future Research

As mentioned above, one aspect of the current study that might have affected its ability to support many of the hypotheses is the nature of the learning task used. The reactor control game was originally designed to study implicit learning, rather than explicit learning (e.g., Berry and Broadbent, 1984; Stanley, Mathews, Buss, & Kotler-Cope, 1989). The task was chosen for this study because its complexity was thought to allow for a great deal of variability in self-efficacy, effort, and performance. In addition, performance on the task was thought to be vague enough to allow for a credible manipulation of normative feedback.

However, the lack of significant findings (e.g., no significant predictors of performance on the task) may be due to the use of an implicit learning task instead of a more traditional explicit learning task. Although implicit learning likely occurs quite often in the workplace, perhaps a very different set of individual difference factors influences learning and performance under these circumstances. Implicit learning involves learning without conscious effort through task experience. It is likely that individuals' goal orientations, which represent motivational variables, come into play to the greatest extent when an individual is purposely trying to learn a task. For example, Fisher and Ford (1998) found that LGO was positively related to the amount of cognitive effort put into learning and to the use of effective learning strategies such as elaboration. In retrospect, the research questions dealing with performance might have been tested more appropriately with an explicit learning task where such strategies could have been of greater utility. In fact, future research could examine whether certain individual difference variables have differential predictive validity for implicit versus explicit learning.

In addition to a possible negative effect on the ability to detect significant performance findings, the task chosen for this study might have had a detrimental effect on the self-efficacy tests. For example, it was hypothesized that feedback sign would have a greater effect on changes in self-efficacy of individuals high in the performance goal orientations, than of individuals low in the performance goal orientations. These hypotheses were based on the idea that these individuals would interpret feedback as a sign of ability, which would influence their self-efficacy judgments. However, as mentioned previously, self-efficacy is a complex judgment influenced by multiple cues (Gist & Mitchell, 1992). One such cue involves individuals' attributions for performance. The trial and error nature of learning for the reactor control game may have caused individuals to attribute a large portion of their performance to "guesswork" or "luck." Thus, self-efficacy may have developed based on how lucky individuals were at guessing the pattern or on how good they are at learning things implicitly, rather than on differences in performance goal orientations.

In light of these task issues, future research might benefit from exploring these same research questions with another task. It might be best to have a task where learning is explicit and follows the typical phases of skill acquisition, starting with declarative knowledge and proceeding through the knowledge compilation and proceduralization stages (e.g., Kanfer & Ackerman, 1989). For instance, it might be advisable to initially present participants with declarative rules for task performance so that there is less guesswork and need for trial-and-error learning. In addition, it might be useful to assess participants' attributions for performance on the task.

It is unclear whether low power was an issue in this study. As mentioned previously, there is still a great deal of work to be done regarding the sample size required for HLM (Bryk & Raudenbush, 1992). Simulation studies have found that there is a trade-off between within-unit and between-unit observations. For example, one estimate indicated that a sample consisting of 150 individuals only requires five observations per person to obtain a power of .90 (Hoffman, 1997). This estimate indicates that the present study had adequate power. On the other hand, several of the hypotheses required testing interaction terms as predictors of level-1 effects. Consistent with work on moderated regression (e.g., McClelland & Judd, 1993), power may be lower when examining interaction effects than when examining main effects in HLM.

Another limitation of this study is the possibility that the normative feedback that some individuals received may have been perceived as inaccurate because it was inconsistent with their perceptions of their actual performance. (For example, they might have been consistently keeping the temperature close to 6000 degrees while at the same time receiving feedback that they were doing much worse than the norm). Therefore, the effects of the feedback manipulation might have been attenuated, resulting in nonsignificant effects for feedback sign as a predictor of performance change. On the other hand, feedback condition did affect self-efficacy change and effort change, indicating that the manipulation worked to some extent.

Another limitation lies in the type of feedback administered. Normative feedback that tells individuals how they are doing compared to others might not be very salient to individuals who are high in learning goal orientation because these individuals tend to concentrate on self-improvement on tasks. Therefore information on how they are doing compared to others might not be as relevant to them as feedback about their own improvement. This could be an explanation for why feedback had less of an effect on self-efficacy for individuals high in LGO than for individuals low in LGO. Another type of feedback, such as self-referenced feedback, might have produced different results. Future research might examine whether different types of feedback interact in different ways with the dimensions of goal orientation. It could be that self-referenced feedback is more salient to individuals high in LGO, while normative feedback is more salient to individuals high in PPGO or PAGO.

Several opportunities for future research on this topic exist. First, there is still a great deal of variance left to be explained in changes in self-efficacy, effort, and performance over the course of a learning episode. Future research might examine other individual difference variables (e.g., conscientiousness, openness to experience, action-state orientation, positive and negative affectivity) and how they affect changes in these variables over time, especially in response to positive and negative feedback.

Second, in light of the significant interaction between feedback sign and LGO on changes in self-efficacy, it would be interesting to explore the potential effectiveness of mastery interventions designed to induce state learning goal orientations (e.g., Kozlowski et al., 2001). These goal interventions might in fact be useful for preventing decreased self-efficacy in the face of negative feedback or failure during task acquisition. Although individuals might not have a natural tendency to approach tasks with a learning orientation, it could be that individuals can be trained to think in such a way.

Finally, it has been suggested that highly task-focused individuals (those with learning goals) are more likely to retain cognitive resources at the task level when receiving feedback, while performance-oriented individuals are likely to shift their attention to the self (VandeWalle et al., 2001). Future research might directly test these ideas by assessing on-task versus off-task cognitions during skill acquisition and examining whether the dimensions of goal orientation predict such cognitions.

Contributions

The present study examined the effects of feedback sign and individual differences in goal orientation on within-person changes in self-efficacy, effort, and performance. One contribution of this research is the statistical approach that was used to analyze the data. Most of the previous research on the effects of goal orientation and feedback has used cross-sectional designs that do not allow for the examination of changes in motivation or performance within a person over time (e.g., Colquitt & Simmering, 1998; Phillips & Gully, 1997; VandeWalle et al., 2001). The data analytic approach used in this study highlights the utility of multilevel analysis for examining the effects of individual difference variables (goal orientation) and situational factors (feedback sign) on variables over time.

A second contribution of this study lies in the finding that LGO and feedback sign interacted in their effects on self-efficacy change. The self-efficacy of individuals high in LGO was less affected by feedback sign than the self-efficacy of those low in LGO. These results speak to the fact that feedback (in the form of performance appraisals or even informal feedback) should not be a one-size-fits-all intervention. Some individuals may be more affected by positive or negative feedback than others (Ilgen et al., 1979). In addition, it was suggested above that type of feedback might interact with individual differences. This research represents a preliminary step in helping managers tailor feedback to fit individuals' own needs in order to maximize its effectiveness. It could be that poor performers who are especially low in LGO might benefit from interventions designed to induce learning goals. These might be used as a supplement to performance appraisal. Another option to explore might be self-efficacy interventions (e.g., verbal persuasion, modeling, changing attributions; Gist & Mitchell, 1992), as a way to compensate for the decreases in self-efficacy that these individuals may experience as a result of negative feedback.

Because the research questions addressed in this study concerned motivation and performance in a learning situation, another contribution of this research lies in its implications for training. It has been shown that learner effort during training is a significant predictor of training outcomes (Fisher & Ford, 1998). Therefore, it is useful to find that LGO and PPGO might help predict the effort that will be put forth during training. It may be beneficial to assess trainees' LGO and PPGO during the needs assessment phase of training design. It might then be possible to design interventions for enhancing effort by enhancing or inducing participants' learning and performance-prove goals.

In conclusion, the research presented here represents several contributions to the field of I/O, including analytic approaches, feedback and performance appraisal, and training and development. Although several of the hypotheses were not supported, possible areas for improvement of the study were identified, and several possible areas for future research were suggested. This topic represents an interesting and useful area for future I/O research.

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Appendix A

Goal Orientation Items (VandeWalle, 1997)

Learning Goal Orientation

1. I am willing to select a challenging assignment that I can learn a lot from.
2. I often look for opportunities to develop new skills and knowledge.
3. I enjoy challenging and difficult tasks where I'll learn new skills.
4. For me, development of my ability is important enough to take risks.
5. I prefer to work in situations that require a high level of ability and talent.

Prove (Performance-prove) Orientation

6. I'm concerned with showing that I can perform better than others.
7. I try to figure out what it takes to prove my ability to others.
8. I enjoy it when others are aware of how well I am doing.
9. I prefer to work on projects where I can prove my ability to others.

Avoid (Performance-avoid) Orientation

10. I would avoid taking on a new task if there was a chance that I would appear rather incompetent to others.
11. Avoiding a show of low ability is more important to me than learning a new skill.
12. I'm concerned about taking on a task if my performance would reveal that I had low ability.
13. I prefer to avoid situations where I might perform poorly.

Appendix B

Self-efficacy Items

1. I feel confident in my ability to maintain the reactor temperature between 5000 and 7000 degrees on the next performance block.
2. I am not confident in my ability to add the correct amount of fuel pellets on the next performance block (reverse scored).
3. I feel confident in my ability to perform well on the next block.
4. I feel unsure of my ability to control the temperature of the reactor (reverse scored).

Appendix C

Effort Items

1. I will work hard to maintain the temperature of the reactor between 5000 and 7000 degrees on the next performance block.
2. I do not intend to put forth much effort on the next performance block (reverse scored).
3. I intend to work intensely on the next performance block.
4. I *do not* plan to try my best on the next performance block (reverse scored).

Appendix D

Manipulation Check Items

1. On the last round, I performed better than roughly ___% of all participants.

2. My performance on the last round was:

1	2	3	4	5
Much worse than average	Worse than average	Average	Better than average	Much better than average

3. Compared to other college students who performed this task, my performance on the last round was:

1	2	3	4	5
Much worse than average	Worse than average	Average	Better than average	Much better than average

Vita

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